VOL. 5 NO. 4
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Energy Research Abstracts

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Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

Volume 5, Number 4, February 29, 1980

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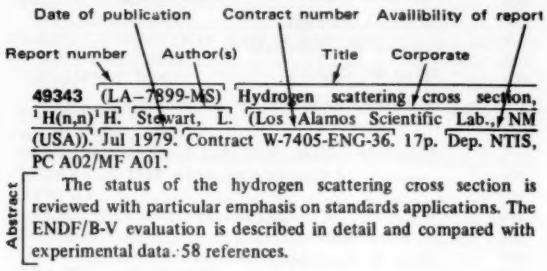
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Contract number
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Author(s)
Title
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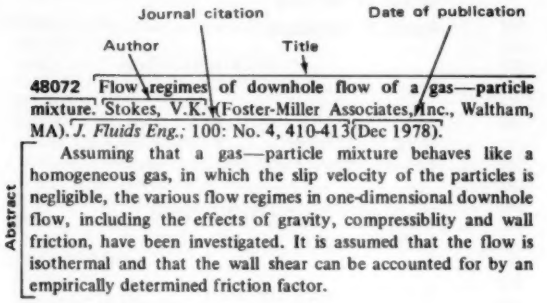
49343 (LA–7899-MS) Hydrogen scattering cross section, $^1H(n,n)^1H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.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Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

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is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Low temperature physics and engineering. Quarterly progress report, January 1–March 31, 1979, 4:48988 (LA–7848-PR)

Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

HYDROGEN 1 TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, $^1H(n,n)^1H$ (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
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78-69	**4:48158**	**Dep. NTIS, PC A03/MF A01**

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 5869, 5891

PROCESSING

REFER ALSO TO CITATION(S) 5361

5226 (CONF-791014—, pp III.40-III.46) **Evaluation of the fracture toughness of candidate steels for pressure vessels for coal conversion systems.** Canonico, D.A. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5227 (CONF-791014—, pp V.28-V.33) **Hot corrosivity of coal gasification products on gas turbine alloys.** Meier, G.H.; Stoehr, R.A. (Univ. of Pittsburgh, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5228 (FE—2449-9) **Chemistry of sulfur in char and the implications for hydrogasification/hydrodesulfurization.** McIver, A.E. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Sep 1979. Contract EX-76-C-01-2449. 289p. Dep. NTIS, PC A13/MF A01.

Thesis.

Experimental results, which elucidate the factors which govern the equilibrium distribution of sulfur between organic sulfur in char and gaseous hydrogen sulfide, are presented. These experiments were conducted at between 1200 and 1600°F, for values of the ratio (P/sub H_2S//P/sub H_2/) ranging from 1 to 100, atmospheric pressure and for several chars. The rank of the parent coals from which these chars were derived ranged from lignite to anthracite. It is shown that the partial pressure ratio (P/sub H_2S//P/sub H_2/) is the pressure-dependent parameter which governs the extent of char sulfidation. It is also shown that the extent of char sulfidation is not uniquely dependent upon char surface area, but decreases with increasing rank of the char, and the rank of the coal from which the char is derived. Char sulfidation is shown to be a reversible process. The kinetics of char desulfurization are shown to be a function of the physiochemical history of the char - i.e., char desulfurization is a path-dependent process. The analogy between the chemistries of oxygen and sulfur in char are explored, and the implications for coal sulfur management are outlined.

CARBONIZATION

REFER ALSO TO CITATION(S) 5322

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 5338

5229 (ACD—38391-17) **Investigation of high velocity wedge separator for particle removal in coal gasification plants. Quarterly report, November 1, 1978-January 31, 1979.** Linhardt, H.D.; Beveridge, J.H.; Boone, C.G. (Airco Cryogenics, Irvine, CA (USA)). 31 Jan 1979. Contract EF-77-C-01-2709. 21p. Dep. NTIS, PC A02/MF A01.

Progress under Contract AC01-77RA02709 is summarized for the period from November 1, 1978 to January 31, 1979. The Ambient Analog Model (AAM) Phase IA and the Phase II effort are discussed. The Phase II effort is directed toward the design, fabrication and testing of prototype wedge separator elements. Significant progress has been made toward the final design of a practical hot gas test article. Starting difficulties have been overcome and the combination of AAM and analytical investigations led to the final hardware design parameters providing a reasonable balance with the objective of high collection efficiency, acceptable total pressure loss and practical dimensions. The first test firing of a solid propellant grain seeded with coal-derived particles has been completed; additional firings are scheduled in order to finalize the test method and the screening instrumentation.

5230 (FE—2295-32-7) **Medium and high temperature gas clean-up of particulates. Quarterly progress report, April—June 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Jul 1979. Contract EX-76-C-01-2295-032. 9p. Dep. NTIS, PC A02/MF A01.

Collection experiments have been carried to 1400°F in a coflow electropacked bed geometry. Redispersed flyash was charged and collected at efficiencies in excess of 99%. Studies on the effect of decreasing electric breakdown strength of packed beds due to increasing temperature have been conducted and the results have been combined with earlier theories of inertial impaction and electrostatic collection mechanisms in a computer model to predict collection efficiencies at high temperaure. Predictions are in excess of 99% efficiency at 1500°F.

5231 (IVL-B—493) **Leaching of metals from pulverized coal.** Loevblad, G.; Steen, B. (Swedish Water and Air Pollution Research Lab., Goeteborg). Apr 1979. 22p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

Different leaching methods have been tested in order to separate metals from pulverized coal. Thus manganese has been separated from coal to a relatively high degree by leaching with a diluted acid. No reduction of the amount of mercury was detected by this method. However, a reduction of the mercury with about 50% was obtained by heating the coal.

5232 (PB—289493) **Assessment of coal cleaning technology: an evaluation of chemical coal cleaning processes. Final report, April 1977-December 1977.** Contos, G.Y.; Frankel, I.F.; McCandless, L.C. (Versar, Inc., Springfield, VA (USA)). Aug 1978. Contract EPA-68-02-2199. 299p. NTIS PC A13/MF A01.

The report assembles and assesses technical and economic information on chemical coal cleaning processes. Sufficient data was located to evaluate 11 processes in detail. It was found that chemical coal cleaning processes can remove up to 99% of the pyritic sulfur and 40% of the organic sulfur, resulting in total sulfur removals of 53 to 77%. This performance can be achieved with heat value recoveries of 57 to 96%. Processes which remove only pyritic sulfur were generally judged to have the highest probabilities of success. Of techniques which remove both pyritic and organic sulfur, the ERDA and GE microwave processes were judged to have the highest probabilities of sucess.

5233 (PB—292328) **Evaluation of the flash desulfurization process for coal cleaning. Final report, November 1975-June 1977.** Fleming, D.K.; Smith, R.D. (Institute of Gas Technology, Chicago, IL (USA)). Jan 1979. Contract EPA-68-02-2126. 155p. NTIS, PC AA08/MF A01.

The report gives results of a program to develop (on the laboratory, bench, and pilot scale) operating conditions for key steps in the 'flash' process for desulfurizing coal by chemical and thermal treatment. Laboratory and bench scale data on high-sulfur eastern U.S. coals prove that the process can reduce sulfur to the point that the resulting solid fossil fuel can be directly consumed in compliance with current regulations for SOx emissions. Because of operating and technical difficulties, pilot scale test data are inconclusive. A preliminary analysis of a conceptual process indicates that the treated fuel would cost $1.50 to 1.75/million Btu (in 1977 dollars on a utility financing basis) if the initial coal cost is $1.00/million Btu.

Four eastern U.S. coals, from abundant seams, were treated under various reducing-gas atmospheres at elevated temperatures. Sufficient sulfur was removed from all coals tested at ambient pressure and at temperatures of 1500 F and residence times of 60 minutes. These data were obtained in laboratory, fixed-bed, continuous weighing reactors and bench-scale fluidized-bed systems. As conceived, the process incorporated a 'sulfur-getter'--a material (e.g., lime) that has a greater chemical affinity for the sulfur than the coal has. Use of a sulfur-getter is required to reduce the H2S concentration in the gas. Data indicate that the concept is sound.

5234 (PSI-TR—167) **Coal processing for fuel cell utilization: Task VIII. H_2S removal by calcium-based sorbents.** Simons, G.A.; Rawlins, W.T. (Physical Sciences, Inc., Woburn, MA (USA)). Mar 1979. Contract EW-78-A-21-8450. 44p. Dep. NTIS, PC A03/MF A01.

Equilibrium calculations indicate an optimum thermodynamic limit of $(H_2S)/(H_2O) \approx 10^{-3}$ for a typical fluidized bed gasification process using limestone or dolomite at temperatures of 1000 to 1200°K; thus, the minimum H_2S level which can be attained in the gasifier is probably near 100 ppM. Detailed kinetic investigations have shown that the kinetic rate constant for CaO with H_2S is of the same magnitude as that with SO_2 and that the activation energy for both reactions is less than 10°K cal/mole. The late time reactivity of H_2S is higher than that of SO_2 because the formation of CaS does not completely obstruct the porous structure of CaO, as does the formation of $CaSO_4$. This offers clear evidence that the sulfur deposits play a role in the late time reactivity. Hence, the next step in the modeling of sulfur cleanup by limestone must include the effects of the sulfur deposits. The first step in generating such a model is to utilize grain theory and the second step is to add sulfur deposits to the pore branching model. In addition to developing a model which includes the effects of sulfur deposits, we must determine the effects of the calcination temperature and CO_2 background on the pore structure. The enhancement of CaO reactivity by lower calcination temperature and higher CO_2 background level has been experimentally observed, although very little quantitative work has been reported. These effects are important for CaO utilization and additional empirical work is required before a theoretical model can be constructed.

HYDROGENATION

REFER ALSO TO CITATION(S) 5363

5235 (FE—2702-7) **Kinetics and mechanisms of catalytic hydroliquefaction and hydrogasification of lignite. Quarterly report, April—June 1979.** Weiss, A.H.; Kranich, W.L. (Worcester Polytechnic Inst., MA (USA)). 12 Jul 1979. Contract EF-77-S-01-2702. 4p. Dep. NTIS, PC A02/MF A01.

After an unsuccessful run in which lignite slurry coked to a solid mass in the reactor, operational problems seem to have been solved. Hydrogenation in the CSTR system at steady state has been successfully carried out on anthracene oil (with and without catalyst) and on a 20% slurry of lignite and cobalt-molybdenum catalyst in anthracene oil at 425°C. Efforts are being devoted to increasing the speed and accuracy of anaytical procedures which are presently perceived as the limiting step in the accumulation of data.

GASIFICATION

REFER ALSO TO CITATION(S) 5229, 5230, 5234, 5315, 5317, 5318, 5330, 5331, 5332, 5344, 5495, 5681, 6093

5236 (CONF-791014—) **Fourth annual conference on materials for coal conversion and utilization.** (Department of Energy, Washington, DC (USA). Div. of Planning and Systems Engineering). 1979. 678p. Dep. NTIS, PC A99/MF A01.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

The fourth annual conference on materials for coal conversion and utilization was held October 9 to 11, 1979, at the National Bureau of Standards, Gaithersburg, Maryland. It was sponsored by the National Bureau of Standards, the Electric Power Research Institute, the US Department of Energy, and the Gas Research Institute. The papers have been entered individually into EDB and ERA. (LTN)

5237 (CONF-791014—, pp 1-31) **Materials design requirements for coal conversion.** Lochman, W. 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

The technology and materials of construction for viable coal liquefaction and gasification complexes are available now. As with any emerging industry, great strides can be made in improving efficiencies, achieving greater reliability, and reducing costs. Making materials available for large sized and uniquely designed equipment is a step forward; more corrosion and erosion resistant materials with improved properties at elevated temperatures will permit the designer and process engineer greater latitude in design and operation, and optimizing materials with design objectives can improve operability, reliability, and maintainability.

5238 (CONF-791014—, pp K.60-K.94) **Refractories for application in slagging gasifiers.** Kennedy, C.R. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

No single refractory that meets all of the requirements set forth by Herron and Baab and Bakker and Crowley has yet been identified for use in the slagging zone. However, water-cooled chrome-spinel, alumina-chromia, and silicon carbide refractories have shown potential for use in contact with coal slags. Further tests of these refractories are forthcoming.

5239 (CONF-791014—, pp K.111-K.145) **Materials development for high temperature gasifier applications.** Dapkunas, S.J. 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

Several programs have evaluated the corrosion resistance of alloys of construction for gasifier internals. The most extensive of these programs is that sponsored by the Department of Energy and the Gas Research Institute of Technology Research Institute. This project consists of exposing samples of alloys to a simulated raw gas at various temperatures and sulfur partial pressures for times up to 10,000 hours. The object of this effort is to gather data useful in the design of gasifier internals. To date, about 60 different alloys have been evaluated and some of these for times greater than 5000 hours. The gas compositions used in this testing are provided in Table IV and the compositions of the alloys tested in Table V. Early tests in the program concentrated on runs of about 1000 hours with variations in temperature and H_2S (up to 1.5 v/o) content. Results showed, as expected, the highest temperature, 1800°F, and highest H_2S level to cause the most severe sulfidation attack. Recent efforts have concentrated on long-term tests at 1650 and 1800°F with H_2S levels of 1.0 and 0.5 v/o respectively. From this test program certain conclusions are given. (LTN)

5240 (CONF-791014—, pp I.1-I.5) **Materials research for the clean utilization of coal. Task 4: failure prevention.** Dobbyn, R.C.; Ondik, H.M. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5241 (CONF-791014—, pp I.6-I.9) **Component performance and failure analysis.** Danyluk, S. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5242 (CONF-791014—, pp II.1-II.12) **Program on materials for the gasification of coal.** Schulz, C.A. (Metal Properties Council, Inc., New York, NY). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5243 (CONF-791014—, pp II.13-II.21) **Design of materials for use under erosion/corrosion conditions at high temperatures in coal gasification and coal combustion systems.** Wright, I.G. (Battelle Columbus Labs., OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5244 (CONF-791014—, pp II.17-II.21) **Corrosion and mechanical behavior of materials for application in coal conversion and utilization.** Natesan, K. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5245 (CONF-791014—, pp II.22-II.27) **Erosion studies in coal conversion systems.** Park, J.Y.; Shack, W.J. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5246 (CONF-791014—, pp II.28-II.32) **Correlation of the high-temperature corrosion behavior of structural alloys with the components of coal conversion environments.** Wright, I.G. (Battelle Columbus Labs., OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5247 (CONF-791014—, pp II.33-II.37) **Sulfidation resistant alloy cladding for internal components coal gasification service.** Perkins, R.A.; Packer, C.M. (Lockheed Palo Alto Research Labs., CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5248 (CONF-791014—, pp II.38-II.42) **Weld overlaying for corrosion resistance in coal gasification atmospheres.** Sadowski, E.P. (International Nickel Co., Suffern, NY). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5249 (CONF-791014—, pp II.43-II.47) **Mechanism of corrosion of structural materials in contact with coal chars in coal gasifier atmospheres.** Douglass, D.L. (Univ. of California, Los Angeles). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5250 (CONF-791014—, pp II.48-II.49) **Development of coatings for corrosion/erosion protection of internal components for coal gasification vessels.** Stevens, W.G. (Solar Turbines International, San Diego, CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5251 (CONF-791014—, pp II.50-II.57) **Development of coatings for corrosion/erosion protection of internal components of coal gasification vessels.** Perkins, R.A.; Packer, C.M. (Lockheed Palo Alto Research Labs., CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5252 (CONF-791014—, pp II.63-II.64) **Materials for in situ processing systems.** LaRue, D.M.; Reimann, G.A. (EG & G Idaho, Inc., Idaho Falls). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5253 (CONF-791014—, pp II.65-II.66) **Thermal stability of ferritic alloys for fossil fuel processing systems.** Polonis, D.H. (Univ. of Washington, Seattle). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5254 (CONF-791014—, pp III.1-III.2) **Design properties of steels for coal conversion vessels.** McCabe, D.E. (Westinghouse Electric Corp., Pittsburgh, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5255 (CONF-791014—, pp III.3-III.8) **Fracture mechanics and surface chemistry studies of steels for coal gasification systems.** Wei, R.P.; Simmons, G.W. (Lehigh Univ., Bethlehem, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5256 (CONF-791014—, pp III.17-III.21) **Low alloy steels for thick walled pressure vessels.** Zackay, V.F.; Parker, E.R. (Univ. of California, Berkeley). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5257 (CONF-791014—, pp III.32-III.37) **Wear-resistant materials for coal conversion components.** Kelley, J.E.; Leavenworth, H.W. Jr. (Bureau of Mines, Albany, OR). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5258 (CONF-791014—, pp III.38-III.39) **Fossil energy welding and cladding program.** Goodwin, G.M. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5259 (CONF-791014—, pp III.47-III-50) **Development of automated welding processes for field fabrication of thick-walled pressure vessels-electron beam method.** Weber, C.M. (Babcock & Wilcox Co., Alliance, OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5260 (CONF-791014—, pp III.64-III.66) **Biaxial testing of candidate coal gasifier alloys.** Horton, R.M. (EG & G Idaho, Inc., Idaho Falls). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5261 (CONF-791014—, pp IiI.67-III.72) **Near-threshold fatigue crack growth in low alloy pressure vessel steels.** Ritchie, R.O. (Massachusetts Inst. of Tech., Cambridge). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5262 (CONF-791014—, pp III.78-III.80) **Analysis of hydrogen attack on pressure vessel steels.** Odette, G.R.; Vagarali, S.; Oldfield, W.; Wullaert, R.A. (Univ. of California, Santa Barbara, CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5263 (CONF-791014—, pp III.81-III.84) **Metastable phenomena in hydrogen degradation of low carbon alloy steels.** Ryba, E. (Pennsylvania State Univ., University Park). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5264 (CONF-791014—, pp III.85-III.88) **Hydrogen attack in Cr-Mo steels at elevated temperature.** Li, C.Yu. (Cornell Univ., Ithaca, NY). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5265 (CONF-791014—, pp III.89-III.90) **Program to optimize Cr-Mo steels to resist hydrogen and temper embrittlement.** Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5266 (CONF-791014—, pp IV.1-IV.4) **Materials research for the clean utilization of coal. Task 2: ceramic deformation, fracture and erosion.** Fuller, E.R. Jr.; Wiederhorn, S.M.; Roberts, D.E.; Robbins, C.R. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5267 (CONF-791014—, pp IV.5-IV.10) **Materials research for the clean utilization of coal. Task 3: chemical degradation.** Mauer, F.; Brower, W.; Hastie, J. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5268 (CONF-791014—, pp IV.11-IV.14) **Testing and development of refractory linings for coal gasification process equipment.** Heystek, H.; Raymon, N.S. (Bureau of Mines, University, AL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5269 (CONF-791014—, pp IV.15-IV.17) **Chemical and physical stability of refractories for use in coal gasification.** Day, D.E. (Univ. of Missouri, Rolla). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5270 (CONF-791014—, pp IV.18-IV.22) **Selection of refractories for slagging coal: conversion systems.** Kennedy, C.R. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5271 (CONF-791014—, pp IV.23-IV.27) **Investigation of CO disintegration of refractories in coal gasifiers.** Brown, J.J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5272 (CONF-791014—, pp IV.28-IV.33) **Improvement of the mechanical reliability of monolithic refractory linings for coal gasification process vessels.** 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5273 (CONF-791014—, pp EV.34-IV.36) **Model for heat flow through refractory linings.** Schorr, J.R. (Battelle Columbus Labs., OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5274 (CONF-791014—, pp IV.37-IV.38) **Numerical thermomechanical model for refractory liner-anchor interactions.** Buyukozturk, O.; Connor, J.J. (Massachusetts Inst. of Tech., Cambridge). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5275 (CONF-791014—, pp IV.39-IV.41) **Fracture of refractory concretes.** Bradt, R.C. (Pennsylvania State Univ., University Park). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5276 (CONF-791014—, pp IV.44-IV.46) **Stability of SiC, Si_3N_4, Si_2N_2O sialon and chromium oxide: containing refractories in coal gasification environments.** Maun, A. (Pennsylvania State Univ., University Park). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5277 (CONF-791014—, pp IV.47-IV.53) **Creep behavior of monolithic refractory materials.** McGee, T.D.; Smyth, J.R. (Iowa State Univ., Ames). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5278 (CONF-791014—, pp IV.56-IV.58) **Design, engineering and evaluation of refractory liners for slagging gasifiers.** Firestone, R.F. (IIT Research Inst., Chicago, IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5279 (CONF-791014—, pp III.13-III.16) **Materials research for the clean utilization of coal. Task 1: metal corrosion.** Smith, J.H. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5280 (CONF-791014—, pp V.42-V.46) **Design of materials for erosion-corrosion conditions in coal gasification and combustion systems.** Barkalow, R.H.; Pettit, F.S. (Pratt & Whitney Aircraft, Middletown, CT). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5281 (COO—2904-14) **Chemical and physical stability of refractories for use in coal gasification. Fourteenth quarterly progress report, August 1, 1979-October 31, 1979.** Fakhr, A.; Day, D.E. (Missouri Univ., Rolla (USA)). 31 Oct 1979. Contract EY-76-S-02-2904. 25p. Dep. NTIS, PC A02/MF A01.

This paper described the corrosion resistance of refractories, especially the bond phases, in high pressure/high temperature gases and liquids present in coal gasification environments. The results of completed exposures are given. Comparison of liquid versus vapor exposure, for the DOE atmosphere, in terms of MOR, for various castables is given. As previously observed for castables exposed to pure steam, all the dense alumina castables had a higher strength after exposure to either the saturated vapor or immersed in liquid, compared with their controls (fired at 5000°F in air for 18 h). The large increase in MOR is attributed to the formation of additional bonding phases, such as boehmite and calcite. With the exception of UMR-8, which showed a higher flexural strength for immersed specimens, all the castables immersed in liquid or exposed to saturated vapor had similar MOR's. Comparison of the flexural strength of dense castables on the basis of the cements and aggregate they contain show that castables containing CA-25 cement (UMR-1 and UMR-8) had a generally higher strength than those containing refcon (UMR-4 and UMR-5). On the other hand, the aggregates (tabular alumina versus calcined kaolin) seem to have no significant effect on the flexural strength of dense castables. Samples made with the same cement, but different aggregates had close to the same MOR. The insulating castables, generally, showed no large change in MOR after exposure to the DOE atmosphere at 1000 psia. The same results were found in the previous tests in the previous tests in pure steam at 410 and 1000 psia.

5282 (FE—2006-14) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, October-December 1978.** Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering). Mar 1979. Contract EX-76-C-01-2006. 86p. Dep. NTIS, PC A05/MF A01.

The main results of two projects out of sixteen are given. Steam reforming of aromatic compounds has shown that dealkylation is faster than ring breakdown. Isomerization and polymerization do not occur. The rate of dealkylation and dehydrogenation decreases with increasing temperature and pressure. Reactivity decreases as the number of aromatic rings in the molecule increases. Coal asphaltenes were shown to contain considerable amounts of hydroaromatic structures which can be dehydrogenated. They also contain acid-base structures which are dissociated by reaction with HCl.

5283 (FE—2204-31) **High Mass Flux coal gasifier. Final report, Phase II.** Simpkin, A.J.; Montanino, L.N.; Reinhardt, T.F.; Berman, K. (Bell Aerospace Textron, Buffalo, NY (USA)). May 1979. Contract EX-76-C-01-2204. 87p. Dep. NTIS, PC A05/MF A01.

This report describes work performed during Phase II of the program to develop a pressurized, single stage, entrained flow, air blown gasifier. The gasifier has an internal volume of 0.5 cubic feet, operates at 15 atmospheres pressure and processes 0.5 ton of coal per hour at a total reactant mass throughput of nominally 10,000 pounds per hour per cubic foot of reactor volume. Four types of injection systems were evaluated and tests of up to one hour duration were conducted using North Dakota lignite, Montana Rosebud, and Pittsburgh Seam coals. A total of twenty-eight gasification tests were conducted. With the better performing injection systems higher heating values in the range 95 to 110 Btu/SCF and carbon conversion efficiencies up to 92% were achieved when operating with North Dakota lignite. Similar performance levels were obtained with Montana Rosebud sub-bituminous coal. Limited testing with Pittsburgh Seam bituminous coal yielded lower performance and reactor modifications to improve performance were identified. Applications and economic studies identified the gasifier to be an attractive means of producing low Btu gas for a combined cycle power plant. A conceptual design of a 140 ton per hour gasifier for use in a three gasifier 830 MW combined cycle power plant was produced. The application studies also identified an oxygen blown version of the High Mass Flux gasifier to be, potentially, a very attractive option for the generation of medium Btu fuel gas, chemical feed stock and a feed stock for substitute natural gas production. Potential problem areas in the development of the gasifier to commercial applications were analyzed and an overall plan and schedule for development of the gasifier was defined.

5284 (FE—2480-20) **Large pilot plant alternatives for scaleup of the catalytic coal gasification process. Final report.** Cohen, S.J. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jan 1979. Contract EX-76-C-01-2480. 408p. Dep. NTIS, PC A18/MF A01.

This is the final report for US Department of Energy Contract No. EX-76-C-01-2480, Scaleup Requirements of the Exxon Catalyzed Coal Gasification Process. The objective was to develop the information necessary to determine if an existing DOE large pilot plant could be used to obtain the scaleup data necessary to design and construct a Catalytic Coal Gasification (CCG) pioneer plant with acceptable risk. A pioneer plant is a stand-alone facility, whose primary function is to operate as a profitable commercial venture. The pioneer plant would contain all equipment of full commercial size, as defined by the requirements for an optimum-sized commercial plant. However, the pioneer plant could have a single train of equipment in some or all of the plant sections. The three tasks contained in this contract are discussed: study design and cost estimate for a grass-roots large pilot plant; selection of the preferred existing pilot plant; and study design and cost estimate for revamp of the preferred existing pilot plant.

5285 (FE—2570-18) **Coal Gasification Project: Douglas Site, Pike County, Kentucky. Quarterly report, August-October 1978.** Hollinger, R.A. (Mason and Hanger-Silas Mason Co., Inc., Lexington, KY (USA)). Dec 1978. Contract EF-77-A-01-2570. 9p. Dep. NTIS, PC A02/MF A01.

Cooperative Agreement No. EF-77-A-01-2570 between Pike County, Kentucky and ERDA (DOE), which was signed in April 1977, established a project to construct and cooperatively manage a low Btu coal gasification system, called an Energy Plant, in an environmentally acceptable manner at the Douglas Site located in Pike County, Kentucky. This Energy Plant is to supply hot and chilled water, for heating and cooling, to a multi-use community composed of residences, a health care facility and commercial buildings, and is to provide a test situation from which a data base may be developed to furnish technical, cost, and operational data for the future use of low Btu coal gasification facilities. In addition to the above, it is intended to sell the gas produced over and above that required to satisfy the heating and cooling demand load to future industries to be located in the Douglas Site. Mason and Hanger-Silas Mason Co., Inc., of Lexington, Kentucky, has been retained by Pike County, Kentucky to design the Energy Plant and to provide the necessary construction management services during the construction phase.

5286 (FE—2570-21) **Coal gasification project: Douglas Site, Pike County, Kentucky. Quarterly report, November 1978—January 1979.** Hollinger, R.A. (Mason and Hanger-Silas Mason Co., Inc., Lexington, KY (USA)). Feb 1979. Contract EF-77-A-01-257. 13p. Dep. NTIS, PC A02/MF A01.

Cooperative Agreement No. EF-77-A-01-2570 between Pike County, Kentucky and ERDA (DOE), which was signed in April 1977, established a project to construct and cooperatively manage a low Btu coal gasification system in an environmentally acceptable manner at the Douglas Site located in Pike County, Kentucky. This Plant is to supply hot and chilled water, for heating and cooling, to a multi-use community composed of residences, a health care facility and commercial buildings, and is to provide a test situation from which a data base may be developed to furnish technical, cost and operational data for the future use of low Btu coal gasification facilities. In addition to the above, it is intended to sell the gas produced over and above that required to satisfy the heating and cooling demand load to future industries to be located in the Douglas Site. Mason and Hanger-Silas Mason Co., Inc., of Lexington, Kentucky, has been retained by Pike County, Kentucky to design the plant and to provide the necessary construction management services during the construction phase.

5287 (FE—3031-1) **Design and simulation of a recirculating bed reactor for coal hydrogasification. Quarterly report, July 1-September 30, 1978 .** Bierl, T.W. (Carnegie-Mellon Inst. of Research, Pitts-

burgh, PA (USA)). Oct 1978. Contract ET-78-S-01-3031. 31p. Dep. NTIS, PC A03/MF A01.

This report elucidates the structure of the program and reviews progress for the first quarter of this contract. Progress to date has been confined to establishing the information base on which the design and simulation of a recirculating bed hydrogasifier will proceed. Available literature on hydrogasification indicates that optimal reactor performance will be established by balancing the competing effects of hydrogen partial pressure, methane concentration in product gas, solid and gas residence time, reactor capacity and the reactor heat balance. The analysis of the hydrodesulfurization literature indicates that hydrodesulfurization is possible and that an alternative process strategy which produces low sulfur char and methane is a possible alternative to a process outputing only methane.

5288 (LA—8060-MS) **Water use for coal gasification: how much is appropriate.** Abbey, D. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

This report reviews the engineering economics of water use for high-Btu coal gas plants and examines the sources of supply and water system designs of plants proposed by industry. Water use varies from a minimum of 2000 acre-ft/yr to 10,000 acre-ft/yr per 250 million fts/day plant, depending particularly on the moisture content of the coal and the use of dry cooling. Costs in excess of $2/10^3 gal ($650/acre-ft) promote the minimum water use. Of the coal gas plants proposed by industry, water from Bureau of Reclamation storage projects is the principal source of supply. Several plant designs indicate use of all-evaporative cooling; several others indicate extensive use of dry cooling. Most of the projects, however, are in holding awaiting either sharply higher natural gas and oil prices or federal subsidies.

5289 (MIT—2295T9-12) **Computer-aided industrial process design: the ASPEN Project. Eleventh quarterly progress report, December 1, 1978-February 28, 1979.** (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Mar 1979. Contract EX-76-C-01-2295. 168p. Dep. NTIS, PC A08/MF A01.

The list of unit operation models has been modified on the advice of the advisory committee. The number of models has decreased from the one reported in the Tenth Quarterly Report but the capability of ASPEN has not changed. Now all ASPEN models will be able to handle solid streams and there will be fewer models with more options. The implementation and integration of a basic ASPEN system was accomplished. This means that input data can be processed to produce the Problem Data file and Program File, that the Program File can be compiled and loaded to create the Simulation Program, and that the Simulation Program can read the Problem Data File and execute unit operations models. Several features were added to the Program Development and Maintenance System. These features make ASPEN easier to debug over the short term and easier to maintain over the long term. Work continued on the Benchmark Problems. This work has concentrated on the gathering and correlation of the data and the development of the specialized reactor models required to perform these simulations.

5290 (MLM—2671(OP)) **Pricetown I: in-situ coal conversion field test for bituminous coals.** Zielinski, R.E.; Seabaugh, P.W.; Agarwal, A.K.; Larson, R.J.; Liberatore, A.J.; Martin, J.W.; McClung, J.D. (Mound Facility, Miamisburg, OH (USA); Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). 1979. Contract EY-76-C-04-0053. 33p. (CONF-791204—2). Dep. NTIS, PC A03/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

An Underground Coal Conversion (UCC) field test in bituminous coal is currently in progress near Pricetown, West Virginia. This test is being performed by US DOE's Morgantown Energy Technology Center (METC) with the primary objective of testing the viability of Linked Vertical Well technology to recover the 275 meter-deep, 2 meter-thick coal resource. The field test is being continuously monitored in real time by an acquisition and control system comprised of a host minicomputer and four satellite microprocessors linked to process and analytical instrumentation. Preignition air injection tests and argon tracer tests were performed prior to ignition of the coal seam. These studies provided conductance information for air through the coal seam. Following ignition, the coal seam was prepared for gasification by the reverse combustion linkage (RCL) process. This process increased coal seam permeability and enabled gasification to be initiated. During the RCL phase of the test, the quality of the produced gas averaged 240 BTU/SCFM. The methane content of the produced gas was higher than that observed in field tests performed in western sub-bituminous coal. This high methane content has been attributed to the nature of the bituminous coal which has a very high volatile matter content. The methane formation can be accounted for by thermal and hydrocracking of tars and oils along with hydropyrolysis and hydrogasification of coal char. Gasification is currently in progress.

5291 (SAN—13108-27) **Underground gasification for steeply dipping coal beds. Quarterly progress report, October 1-December 31, 1978.** (Gulf Research and Development Co., Pittsburgh, PA (USA); TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Feb 1979. Contract EF-77-C-03-1472. 73p. Dep. NTIS, PC A04/MF A01.

Due to DOE contractual changes, the UCG-SDB project had to be extensively altered. A new set of objectives was established for Test No. 1, which now includes an increased injection rate, three instrumentation wells, and a design life of 40 days. The hydrological studies being conducted at the site presently indicate that the G coal seam and its boundary strata have extremely low transmissibilities. If these observations are verified, the environmental impact of UCG on the groundwater will be negligible. An Environmental Impact Assessment has been written and submitted to DOE for review. Air and water quality baseline monitoring is continuing. It was necessary to augment our in-house design staff to meet the revised Test No. 1 date. Emphasis was concentrated on firming up the area plot plan and instrumentation diagrams and producing detailed design drawings and procurement packages.

5292 **Synthetic fuels from peat.** Punwani, D.V. Chicago, IL; Institute of Gas Technology (1979). 44p. (CONF-790770—1).

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

On the basis of chemistry and kinetics, peat is an excellent raw material for the production of synthetic fuels. Cost estimates made on the conversion of Minnesota peat to SNG are competitive with production of SNG from other fossil fuels. It might also be competitive to produce other synthetic fuels from peat. IGT has conducted over 200 tests with peats from Minnesota, North Carolina, and Maine in laboratory- and PDU-scale equipment. In order to advance the technology for production of synthetic fuels from peat, tests should now be initiated at the pilot plant scale of operation. Peats from different regions of the US could have different characteristics as demonstrated by peats from Minnesota, North Carolina, and Maine. Tests with other peats should also be initiated in laboratory- and PDU-scale equipment.

5293 **Instrumentation and controls experience at the IGT U-GAS Pilot Plant.** Rehmat, A.; Vora, M.K.; Sandstrom, W.A. Chicago, IL; Institute of Gas Technology (1979). 13p. (CONF-790855—6).

From Symposium on instrumentation and control for fossil energy processes; Denver, CO, USA (20 Aug 1979).

At the Institute of Gas Technology, several coal and char gasification pilot plant programs to produce low- and medium-Btu gas have been successfully conducted during the last 6 years. The U-GAS process consists of a single-stage fluidized-bed gasifier containing an ash agglomerator that achieves selective removal of high-ash-bearing material (agglomerates) and high carbon conversions. The three foot (0.091 m) diameter pilot plant reactor has produced quality medium-Btu gas at atmospheric pressure, over an operating temperature range of 1500° to 1950°F (816° to 1066°C). This paper reviews the instrumentation techniques utilized for measurement and control of process variables for successful start-up, steady-state operation, and upset recovery in the U-GAS Pilot Plant. These variables include fluid bed level, density, temperature, pressure and process gas input and product gas flow rates. Emphasis is placed on the instrumentation and control methods pertaining to the gasifier (bed height, temperature and pressure), selective ash removal and elutriated fines reinjection. The need for additional control features on demonstration-scale plants is also stipulated. To date, gasification tests have been successfully conducted using metallurgical coke breeze, bituminous coal chars, Montana subbituminous, Illinois No. 6, and washed and unwashed Western Kentucky No. 9 bituminous coals. U-GAS process tests have been completed to produce design data at 60 psia (413 kPa) for an Industrial Fuel Gas Demonstration Plant.

LIQUEFACTION

REFER ALSO TO CITATION(S) 5236, 5237, 5240, 5241, 5257, 5282, 5289, 5292, 5318, 5344, 5495, 6093

5294 (CONF-790822—14) **Riser cracking of coal to gasoline, fuel oil, and gas.** Oberle, R.D.; Duncan, D.A.; Beeson, J.L. (Institute of Gas Technology, Chicago, IL (USA)). 1979. 29p. Inst. of Gas Tech., Chicago, IL.

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

Operating conditions and typical yields from IGT bench-scale investigations of short-time hydropyrolysis of lignite coal are shown. The basis for reactor selection of a short residence time process development unit (PDU) and a commercial riser cracker concept is discussed. The PDU design features are discussed and a reactor sketch is included. A flow diagram of the commercial concept is shown and specific features of the riser reactor, fluid bed slurry dryer and quench vessels, carrier hydrogen recycle gas system,

hydrogen enrichment, heat exchange, and product recovery system for the commercial unit are illustrated and discussed. Typical yields of gasoline and alternate chemical products for a high severity run are priced out for a chemicals case and for a fuels case. Anticipated operating costs based on three assumed investment costs are developed. Upon crediting the operation for the by-products (i.e., all except gas), the cost attributable to the product gas is developed for the various levels of investment. Sensitivity of gas cost to the capital charges is shown for the chemicals and fuels cases.

5295 (CONF-791014—, pp K.1-K.59) **Materials for coal liquefaction.** Scott, T.E. (Iowa State Univ., Ames). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

A deliberate effort was made to demonstrate that coal liquefaction processes encompass a host of challenging materials problems. The most pressing of these is erosion of valves and pumps. But, the solution of many others will improve long-term reliability and will reduce plant and operating costs. The alarmist or pessimist attitude was intentional. However, it is almost certain that the immediate problems will be solved and demonstration plants will be operating well in advance of solutions to most of the materials problems discussed. In fact many of the potential problems indicated may never materialize. Nevertheless, the writer is convinced that substantial efforts to understand the nature of and to solve these problems should continue through and beyond the demonstration plant stage of coal liquefaction development. Exact solution may not be obtained but their pursuit, without doubt, will lead to knowledge that will benefit the new industry ultimately.

5296 (CONF-791014—, pp I.16-I.19) **Failure prevention and analysis in coal liquefaction systems.** DeVan, J.H.; Baylor, V.B.; Kieser, J.R. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5297 (CONF-791014—, pp III.9-III.12) **Alloy evaluation for fossil fuel process plants (liquefaction).** Scott, T.E. (Ames Lab., IA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5298 (CONF-791014—, pp III.51-III.55) **Evaluation of materials for use in letdown valves for coal liquefaction service.** Mueller, J.J.; Wright, I.G. (Battelle Columbus Labs., OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5299 (CONF-791014—, pp III.56-III.58) **Coal liquefaction alloy test program.** Levy, A.V. (Lawrence Berkeley Lab., CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5300 (CONF-791014—, pp III.59-III.61) **Liquefaction corrosion.** DeVan, J.H.; Keiser, J.R.; Baylor, V.B. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5301 (CONF-791014—, pp III.62-III.63) **Zinc chloride recuperator study.** DeVan, J.H.; Keiser, J.R.; Baylor, V.B. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5302 (EPRI-AF—1122) **Diverse liquefaction behavior of various bituminous coals in the SRC-I process: an engineering and economic evaluation.** McNamee, G.P.; Patel, N.K.; Ferry, L.N.; White, G.A. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Jul 1979. 194p. Dep. NTIS, PC A09/MF A01.

Process engineering evaluations were prepared for two coal liquefaction concepts described in Volume 1 of Research Project 411-1. These evaluations were made within the framework of complete self-sustained plants. The two liquefaction concepts considered were the non-catalytic Solvent Refined Coal process and a generic catalytic hydroliquefaction process referred to as the CHL process. The engineering designs and capital cost estimates were developed for a southern Illinois location using the same general process configuration and supporting units for both liquefaction systems. The designs were based on the use of commercially demonstrated technology wherever possible to provide a common basis for comparing the first generation cost of the alternates considered here with those evaluated earlier. The original design cases were intended to be base cases for assessing the cost impact of process improvements that could be incorporated into subsequent designs. Two cases representing SRC technology (Wilsonville, Alabama pilot plant results) are described herein based on operation with different types of coal than previously considered. The designs are developed for plants with a nominal product capacity (including residual fuel) of 50,000 barrels per day of fuel oil equivalent. As expected, the findings of this study confirmed that the cost of SRC product depends on the liquefaction behavior of the coal feedstock increasing as the processing severity required increases. However, two aspects, both of which are more related to the SRC-1 process itself than to the diverse liquefaction behavior of various coals, should be given special consideration. These are: 1) control of solvent quality, and 2) SRC product quality.

5303 (EPRI-AF—1157) **Solvent-refined coal process: data correlation and analysis. Final report.** Frith, J.F.S; Viswanathan, S.; Gupta, A. (Lummus Co., Bloomfield, NJ (USA)). Aug 1979. 308p. Dep. NTIS, PC A14/MF A01.

The objectives of the study were to evaluate available pilot plant and other experimental data on coal liquefaction and develop useful correlations for design and scale-up to commercial size plants. The available operating data from three pilot plants, the bench scale unit operated by Hydrocarbon Research, Inc., the six-ton per day pilot plant at Wilsonville, Alabama and the 50-ton per day demonstration unit at Tacoma, Washington, were studied. The reviewed data was organized into comparative tables to facilitate its use in subsequent studies. To reduce the data into forms useful for design calculations, a number of correlations were developed. Product yields were correlated with reaction severity expressed as hydrogen consumption. The liquefaction reactions were studied by calculating reaction rate constants for the processes of hydrogen consumption, coal conversion and organic sulfur removal. To aid in the design of the vapor-liquid separation equipment, a means of characterizing coal liquids was proposed. This was used successfully with methods that are currently available to predict physical properties and vapor-liquid equilibria for petroleum mixtures. Recommendations on the use of these correlations for the design of commercial sized SRC plants were developed and an example is illustrated in the report. Study of the available data leads to several observations regarding means to improve the value and quality of the data in future pilot plant operations. These are discussed.

5304 (EPRI-AF—1184) **Exploratory studies in catalytic coal liquefaction. Final report, June 1978-March 1979.** Whitehurst, D.D.; Mitchell, T.O.; Farcasiu, M.; Dickert, J.J. Jr. (Mobil Research and Development Corp., Princeton, NJ (USA)). Sep 1979. 166p. Dep. NTIS, PC A08/MF A01.

HRI, has run catalyst aging tests simulating H-coal conditions with Illinois No. 6 coal for ~ 10 days with Cyanamid 1442A ($CoMo/Al_2O_3$), Cyanamid $NiMo/Al_2O_3$, Armak $NiMo/Al_2O_3$, Amocat 1A ($CoMo/Al_2O_3$), and Amocat 1B (Mo/Al_2O_3) catalysts. From each test we obtained fresh catalyst, aged catalyst from the end of the run, and total reactor effluents (less gases) from various times during the run. In a test developed at Mobil using a fixed bed, high pressure downflow reactor and model compound mixtures, we examined fresh and aged catalysts for hydrogenation, hydrocracking, isomerization, desulfurization, denitrogenation, and deoxygenation. Several minerals were also included in the tests. Activities, selectivities and deactivation are discussed. Fresh commercial catalysts, especially $NiMo/Al_2O_3$, appear to be undesirably active for the H-Coal process. Amocat 1B is the least active. All catalysts age extensively but the used catalysts are still quite active. Activities for all reactions are reduced in the presence of nitrogen compounds. Hydrocracking activity appears to be critical to denitrogenation effectiveness. Examination of the products of the HRI catalyst aging runs confirms the interpretations of the model compound tests. Also, it is found that $400°F^+$ product mixtures become more complex as catalysts age, and that the catalysts affect especially the highest (largest size) boiling products, but lose the ability to lower molecular weight as they age. A brief examination of novel hydrogen donor-catalyst systems is also described.

5305 (FE—2213-T2) **Coal liquefaction material balance and yield reporting procedures.** (TRW, Inc., Redondo Beach, CA (USA)). Jul 1977. Contract EX-76-C-01-2213. 73p. Dep. NTIS, PC A04/MF A01.

Diverse procedures have been formulated for calculating and reporting material balances and product yields for coal liquefaction process units. These differences can present problems in extracting the maximum amount of useful information from the raw data generated by coal liquefaction pilot plants and process development units and include the: primary measurements used to obtain input and output stream mass flow rates; techniques used to sample and determine the elemental analyses and composition of streams used in calculating mass balances; methodologies practiced for forcing overall and elemental mass balances to closure; manner by which raw flow and analytical data are adjusted or normalized to meet mass balance constraints; and products for which yields are reported and the bases by which they are calculated. These differences in analyzing and reporting coal liquefaction process data can create difficulties in comparing and evaluating the various processes. In order to understand and eventually overcome these problems, and to promote the exchange of technical information, six coal liquefaction processes were selected for studying and reporting current material balance procedures. These processes are: Solvent Refined Coal (SRC), H-

Coal, Lummus Clean Fuels from Coal, Synthoil, Cresap, and Exxon Donor Solvent (EDS). The information collected is described in detail.

5306 (FE—2547-35) **Laboratory program to support H-Coal Pilot Plant operations: bench-scale tests on Kentucky No. 11 coal.** Comolli, A.G.; Johanson, E.S. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Jun 1979. Contract EF-77-C-01-2547. 72p. Dep. NTIS, PC A04/MF A01.

Hydrocarbon Research, Inc., conducted a bench-scale program to evaluate Kentucky No. 11 coal in the H-Coal system. The test used standard operating conditions, and performance was judged against that of Illinois No. 6 coal which has been used in other H-Coal studies. The H-Coal process operations with Kentucky No. 11 coal are similar to those with Illinois No. 6 coal feed. However, due to the physical property differences of the recycle oil, an adjustment in feed composition and/or temperature appears to be required for sustained coal feeding. The Kentucky No. 11 coal gave about 1.5 W % higher coal conversion than Illinois No. 6. At the catalyst age studied, the Kentucky coal yield of C_4-975°F distillate was about 2 W % higher. The residual oil yields were similar for both coals; the Kentucky coal yielded a higher proportion of toluene insolubles. The sulfur content of the residual oil was about 0.1 W % higher for the Kentucky coal. Product nitrogen and hydrogen contents were similar for both coals. Based on the operating results of these bench unit runs on Kentucky No. 11 coal, a larger scale PDU (3.5 tons/day) run is recommended. On the PDU scale, recycles are continuous and equipment is designed for similarity and relevance to Pilot Plant operations.

5307 (FE—2547-36) **Laboratory program to support H-Coal pilot plant operations. Low pressure-bench-scale operations.** Comolli, A.; Johanson, E. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Jun 1979. Contract EF-77-C-01-2547. 52p. Dep. NTIS, PC A04/MF A01.

Process economics studies of the fuel oil mode of operation at lowered hydrogen partial pressure indicated that the potential capital saving of reduced pressure design outweighs the cost of increased catalyst usage needed to maintain product yield and quality. Because the yields, product properties and catalyst deactivation rates were an extrapolation of the existing data base, it was recommended that experimental work be done to verify this observation. On the basis of an experimental program conducted at the HRI R and D Center, the following conclusions were reached: lower pressure operation can yield an economic, as well as mechanical, benefit (1140 psi vs 1800 psi hydrogen partial pressure at the reactor outlet); test results from this bench run support most of the findings of an engineering study on a commercial design case at a lower hydrogen partial pressure (1200 psi). The experimental yields and predicted yields agree with each other within 2%, while the experimental data show a lower sulfur content and lower apparent viscosity than predicted; the spent catalyst from the low pressure run had a higher carbon content, by 4 W% (16.3 vs 11.6 W%), than the spent catalyst from a standard pressure run. Recovery of pore volume on ignition was equivalent for each (93%).

5308 (LBL—9372) **Coal conversion catalysis using zinc chloride in organic media.** Shinn, J.H.; Vermeulen, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemical Engineering). Sep 1979. Contract W-7405-ENG-48. 253p. Dep. NTIS, PC A12/MF A01.

The conversion of coal to soluble materials and liquids requires cleavage of chemical bonds. Because these bonds are inaccessible to contacting with conventional solid catalysts, current coal-processing technology uses high temperature to initiate bond cleavage, with high hydrogen pressures and hydrogen-donor solvents in high concentration to cap the cleaved bonds. Undesirable side reactions of two types - repolymerization and fragmentation - accompany the conversion, wasting both coal and hydrogen. This study examines the use of liquid catalyst systems to penetrate the coal and carry out the cleavage reactions at temperatures well below where thermal cleavage occurs. In one hour runs at 250°C, solutions of $ZnCl_2$ in water proved quite ineffective at converting coal to pyridine-soluble components, giving only 25% solubility from coal originally 12% soluble. $ZnCl_2$-methanol solutions were considerably more effective yielding a product with 70% pyridine solubility. About 0.2 gm of methanol per gram of treated coal are chemically incorporated in the product during such treatment. Based on the results, a mechanism for catalytic solubilization is proposed. This involves penetration of the catalyst into the coal structure, activation of the crosslinks in the coal polymer by the catalyst, capping of cleaved bond fragments by hydrogen or solvents, and solvation of products so as to leave the unreacted coal accessible for further conversion. The action of the methanol appears to be multifunctional. It improves contacting, serves as a capping agent, facilitates product removal, and perhaps also promotes the catalyst activity. A decrease in oxygen content of the coal accompanies the solubilization, suggesting that ether bonds are the important linkages for which cleavage leads to solubilization.

5309 (METC/CR—79/11) **Facility requirements for testing control valves for slurry letdown service.** Gardner, J.F. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center; TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Jun 1979. 25p. Dep. NTIS, PC A02/MF A01.

The US Department of Energy, Morgantown Energy Technology Center (METC) has been designated the lead center for the development and testing of components for coal conversion and utilization applications, and has been active for the past several years in the development and testing of valves, coal extruders, and gas cleanup systems. METC has initiated new valve test and development projects. This test plan covers a valve for slurry letdown service in a coal liquefaction plant. Since large scale (commercial size) testing facilities do not exist, and would be very expensive and time consuming to construct, this test plan assumes that valves will be tested at an existing pilot plant facility or in special, small scale test loops. Included in this document are the program objectives, a description of the tests, and the facility functional requirements criteria delineated as follows: operational requirements, operating personnel requirements, maintenance requirements, equipment requirements, instrumentation and data recording requirements, utility requirements, and transportation/storage requirements.

5310 (UCRL-Trans—1586) **Fischer-Tropsch synthesis in the liquid phase.** Koelbel, H.; Ralek, M. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technische Chemie). Sep 1979. Tanslation source information not available. 76p. Dep. NTIS, PC A05/MF A01.

The liquid-phase F-T synthesis takes place in a bubble column reactor where the synthesis gas is converted on catalysts suspended in a liquid as fine particles. The synthesis gas flows as small bubbles through the catalyst suspension. The synthesis products, which are volatile under the operating conditions employed, are removed with the residual gas, and the liquid products are separated from the suspension. The heat of reaction is removed by water evaporated in cooling pipes immersed in the suspension. The use of the bubble column reactor for F-T synthesis has the following advantages, which are discussed in detail in the paper: uniform temperature in the reactor; high contact and reactor efficiency; a catalyst efficiency of about 1; good heat exchange; favorable conditions for catalyst regeneration; and simple construction and therefore low investment costs. Control of the heat of reaction, which reaches a considerable order of magnitude, does not present any problem. It is necessary to eliminate local overheating because it leads to methane formation and damage to the catalyst. The flexibility of the suspension reactor makes it possible to establish specific operating conditions permitting a selective control of the synthesis and therefore its economical operation. The bubble column reactor allows the introduction of synthesis gases rich in carbon monoxide without the risk of clogging or some other undesirable effect that might be caused by the liberation of carbon by the Boudouard reaction. The special features of the three-phase bubble column reactor do exert an influence on the reaction process of the F-T synthesis. Detailed information on the behavior of bubble column reactors can be found in the literature to which references are given.

5311 **Materials study for $ZnCl_2$ recuperation system of Conoco zinc chloride process.** (Oak Ridge Natl Lab, Tenn). pp III.61-III.62 of Materials for coal conversion and utilization. DeVan, J.H. Washington, DC; Dept. of Energy (1978).

From 3. conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (10 Oct 1978).

The goal is to identify materials of construction which can resist the corrosive attack of the zinc chloride recuperation environment. Metals that may be exposed include Inconels 600 and 601, alloy 800, Hastelloy C-276, and other Ni-base alloys. Other materials may be ferritic stainless steels and refractories.

PROPERTIES

REFER ALSO TO CITATION(S) 5302, 5314, 6026, 6029, 6038

5312 **Thermal, mechanical, and physical properties of selected bituminous coals and cokes.** Singer, J.M.; Tye, R.P. Washington, DC; Bureau of Mines (1979). 41p. (BM-RI—8364).

Thermal, mechanical, and physical properties of virgin and heat-treated Pittsburgh seam coal were determined as part of a comprehensive study of combustion of monolithic coal block. The information was sought to help characterize pyrolysis and combustion processes in underground coal mine fires but should also prove useful in the study of in situ and surface coal gasifiers. Measured properties include thermal conductivity, specific heat, thermal expansion, density, compressive and tensile strength, porosity, and permeability. The transport property data were obtained (when feasible) in two mutually perpendicular directions of the anisotropic virgin coal material, and coal samples carbonized after 5 hours at

temperatures of 350°C, 475°C, 500°C, 650°C, and 850°C. Other coals (Pocahontas No. 3, Sewell, and Illinois No. 6 seams) were investigated for porosity and relative permeability. Interdependence among all properties was evident from the results; however, only a few correlations could be developed owing to inhomogeneity of coal material and specimen variation, which had the effect of reducing the accuracy of measurement and increasing data scatter.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5339

5313 (EPA—600/7-79-067b) **EPA industrial boiler FGD survey: first quarter 1979.** Tuttle, J.; Patkar, A.; Kothari, S.; Osterhout, D.; Heffling, M.; Eckstein, M. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Apr 1979. 236p. NTIS.

The first full-scale United States application of flue gas desulfurization (FGD) technology to industrial boilers was at the General Motors plant in St. Louis, Missouri, where two FGD systems were installed on two coal-fired boilers in 1972. In this 1st quarter 1979 report, 126 operational FGD systems are described. These systems are controlling SO2 emissions from 232 boilers, located at 36 plant sites across the United States. FGD systems at 21 plants are known to be under construction or in some stage of planning. In addition there are 6 installations included in the report where FGD operations have either been terminated, indefinitely shut down, or never started-up. The total coverage of this report is therefore 63 installations. A brief description of the process is given for several installations. Of the more than 170 active (operating, under construction, or planned) FGD units addressed in this report, more than half are being used or scheduled to be used in enhanced oil recovery (EOR) sites in California. Because of the fact these units predominate in this report, a brief discussion of the EOR industry is given.

5314 (EPRI-FP—1030) **Lime FGD Systems Data Book. Final report.** (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). May 1979. 714p. Dep. NTIS, PC A99/MF A01.

This manual represents a joint effort of EPRI nd the US Environmental Protection Agency (EPA). It was written as an aid to utility engineers involved in the design, specification, project management, and operation of lime-based, flue gas desulfurization (FGD) systems. The information is aimed at technical personnel who already have knowledge of utility power plant operations but may not be familiar with the chemical processes and equipment that comprise FGD systems. To date, lime-based FGD systems account for approximately 11,000 MW out of 28,000 MW of FGD capacity installed or under construction. As a result, a large information base is becoming available, but up to now it has not been compiled in a format that is readily accessible and usable by the utility industry. The Lime FGD Systems Data Book should permit a utility to anticipate the performance, reliability, and maintenance characteristics of alternative lime scrubbing system designs available, as a function of site-specific variables. This information should improve the quality of bid specifications as well as the ability to judge the merit of alternative lime scrubbing system proposals. The manual serves to integrate and summarize the results of extensive utility, architect-engineer, vendor, EPA and EPRI efforts in the development of lime scrubbing technology. Much of the information is derived from the results of research projects funded by EPRI and EPA.

5315 (FE—2496-41) **Production, management, and chemistry of coal gasification wastewaters. Tenth quarterly report.** Luthy, R.G.; Walters, R.W. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Energy and Environmental Studies). Mar 1979. Contract EX-76-S-01-2496. 83p. Dep. NTIS, PC A05/MF A01.

The objective of this paper is to discuss the production, management and chemistry of coal conversion process wastewater. The importance of water chemistry is emphasized in relation to wastewater characterization and wastewater reuse in coal gasification processes. Water management and treatment play critical roles in the design of coal gasification facilities. Much of our nation's easily exploitable coal reserves lie in semi-arid regions where municipal, agricultural, and industrial water demands compete for a limited water supply. For these reasons it is necessary that gasification plants be designed to minimize water consumption. A second consideration is that these plants must be environmentally acceptable. This means that maximum attention must be given to treatment of wastewater for reuse in order to effectively eliminate wastewater discharges. Naturally, this goal serves to help minimize water consumption. The quantity of water consumed in a given gasification plant depends mainly on product quality and on the fraction of unrecovered heat disposed of by wet cooling. Water leaves the plant primarily as vapor from cooling towers, as hydrogen in the methane product, and as occluded water in solid residues. Foul process waters which are treated for reuse, rather than being discharged, do not contribute to this consumption. The extent to which these foul process waters must be treated is dependent on the quality of the effluent and the quality constraints governing reuse options.

5316 (NP—24194) **Coal and the environment abstract series: bibliography on disposal of refuse from coal mines and coal cleaning plants.** Gleason, V.E. (comp.). (Bituminous Coal Research, Inc., Monroeville, PA (USA)). May 1978. 188p. NTIS.

Numerous public and private efforts have contributed to the knowledge concerning coal's environmental problems and to their control. This knowledge is well documented, and BCR has been extensively involved in compiling and disseminating it. One facet of this activity has been the establishment of environmental libraries at BCR for use by the public as well as the coal industry, and the publication of bibliographies of abstracts based on these collections. This volume is the second to appear in the Coal and Environment Abstract Series and the third environmentally related volume of abstracts prepared by BCR. The subjects covered in this bibliography include the analysis and characterization of coal refuse; various methods of handling, storing, and disposing of coal refuse; the environmental problems such as refuse drainage quality and combustion of refuse piles; the control of environmental problems; and the uses for refuse which have been investigated. In addition to the abstracts, this volume includes an Author Index and a General Index. Much of the literature abstracted here is available from large libraries, government agencies issuing particular reports, or from the authors. Complete citations have been given so that the reader can obtain material from these sources. We would appreciate receiving copies of any publications not listed here. Any other suggestions, comments, or criticism of this publication are welcomed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5320, 5325, 5361, 6182, 6252

5317 (FE—2570-15) **Coal gasification project: Douglas site, Pike County, Kentucky. Quarterly report, May-June 1978.** Hollinger, R.A. (Pike County Coal Gasification Project, Pikeville, KY (USA); Mason and Hanger-Silas Mason Co., Inc., Lexington, KY (USA)). Dec 1978. Contract EF-77-A-01-2570. 11p. Dep. NTIS, PC A02/MF A01.

Cooperative Agreement No. EF-77-A-01-2570 between Pike County, Kentucky and ERDA (DOE) established a project to construct and cooperatively manage a low Btu coal gasification system, called an Energy Plant, in an environmentally acceptable manner at the Douglas Site located in Pike County, Kentucky. This Energy Plant is to supply hot and chilled water, for heating and cooling, to a multi-use community composed of residences, a health care facility and commercial buildings, and is to provide a test situation from which a data base may be developed to furnish technical, cost and operational data for the future use of low Btu gasification facilities. It is intended to sell the gas produced over and above that required to satisfy the heating and cooling demand load to industries to be located at the Douglas Site in the future. Mason and Hanger-Silas Mason Co., Inc., of Lexington, Kentucky, has been retained by Pike County, Kentucky to design the Energy Plant and to provide the necessary construction management services during the construction phase.

5318 (FE—3182-T1) **Waste disposal, cooling and related environmental impacts associated with synthetic fuel plant siting and design criteria. Part 1. Cooling water consumption. Addendum to first quarterly report.** Goldstein, D.J.; Seufert, F.B. (Water Purification Associates, Cambridge, MA (USA)). 1979. Contract ET-78-C-01-3182. 126p. Dep. NTIS, PC A07/MF A01.

Evaporation for cooling can be a major consumptive use of water in coal conversion and generating plants. In coal conversion plants, the heating value in the raw material not recovered in the synthetic fuel or the byproducts must be transferred to the environment. Some of this unrecovered heat is lost directly to the atmosphere, leaving the plant in hot gases up a flue, in water vapor from coal drying, in convective and radiant losses from machinery and container surfaces, and in other direct ways. However, the largest fraction of the unrecovered heat is indirectly transferred to the atmosphere. The heat to be dissipated may be transferred through a heat transfer surface that is cooled by air. This is called dry cooling, or air cooling, and negligible water consumption is incurred in this method. Alternatively, the heat transfer surface may be cooled by circulating water, which is itself cooled in a cooling tower with evaporation to the atmosphere of a fraction of the water. This is called wet cooling, or evaporative cooling. We are concerned here with these two methods of cooling or their use in combination, termed wet/dry cooling. The economic decision of whether to use wet or dry cooling, or a combination, at any given point of cooling in the plant depends on the true cost of water. This must include any costs to buy water rights and to transport the water to the plants, as

well as the cost to treat the circulating cooling water and to dispose of the cooling tower residues. The economics must be calculated for each type of cooling load in the plant. In this report the study is limited to three loads, interstage coolers on gas compressors, cooling steam turbine condensers and regeneration condensers and other cooling loads in acid gas absorption sections.

5319 (PB—292701) **Environmental effects of western coal surface mining. Part III. The water quality of Trout Creek, Colorado. Final report.** Skogerboe, R.K.; Lavallee, C.S.; Miller, M.M.; Dick, D.L. (Colorado State Univ., Fort Collins (USA). Dept. of Chemistry). Jan 1979. 71p. NTIS, PC AA04/MF A01.

Water quality parameters have been measured at several on-stream and off-stream sites along Trout Creek, which is recipient of water from coal strip-mining operations. Levels of the gross parameters (e.g., specific conductivity), the common ions (e.g., calcium and sulfate), and some trace components (e.g., selenium) are highest in mine spoil drainages. The impact of the mine spoil drainage on the stream is reflected in the larger quantities of dissolved solids and common ions found at on-stream sites adjacent to and below the mine. For trace elements, the mine operation has no detectable impact on Trout Creek in terms of increasing concentrations of Al, As, Cd, Cr, Cu, Fe, Pb, or Zn. Increases in stream concentrations of Mn and Se due to mine inflow can be inferred from the data. Higher concentrations of As, Fe, Mn, Se, and Zn are found in waters draining mine spoils. In the mine spoils, variations in the concentrations of these elements occur with spoil age; more Mn and Zn occur in older spoils, while higher levels of As, Fe, and Se are found in newer spoils. Chemical equilibrium calculations indicate that alkaline precipitation processes can maintain the low concentrations of Al, Cd, Cu, Fe, Pb, and Zn. The general alkaline characteristics of western streams and aquifers suggests that such precipitation equilibria will limit the soluble heavy metal concentrations.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 5349, 5374

5320 **Geohydrologic impacts of coal development in the Narragansett Basin, Massachusetts and Rhode Island.** Frimpter, M.H.; Maevsky, A. Washington, DC; Geological Survey (1979). 35p. (NP—24184). GPO.

The hydrologic impacts of possible coal mining in the 900-square-mile Carboniferous Narragansett Basin in southeastern New England are described. Geophysical tests and hydrologic observations were made in thirteen 3-inch-diameter test holes which were 330 to 1500 feet deep. Fractures and lithology, including graphite and coal, were identified and located from interpretation of geophysical logs. Ground-water levels measured in 1976-77 were less than 15 feet below land surface at all tests sites. Specific capacities of the test holes to yield water ranged from 0.01 to 5.7 gallons per minute per foot of drawdown after short (2 to 5 hour) pumping periods. In a test hole in Halifax, Massachusetts, water levels showing drawdown caused by pumping nearby domestic-supply wells indicate that mine dewatering would reduce yields of private wells tapping bedrock. In test holes near Narragansett Bay, ground water was brackish, and water levels fluctuated with about one-fifth the magnitude of the tide in the bay. These conditions suggest that there is potential for a high rate of mine seepage from the bay. As a result of mining, the iron disulfide minerals, pyrite and marcasite, react with air and water to produce acid water containing iron. However, acid mine water is not expected to be as serious a problem in the Narragansett Basin as it is in the Appalachian coal fields. No marcasite and only small amounts of coarsely crystalline pyrite have been observed in the metamorphosed sediments of the basin.

5321 (FE—5065-10) **Prediction model for compositional changes within coal from core data. 10th quarterly report, October-December 1978.** Renton, J.J.; Donaldson, A.C. (West Virginia Univ., Morgantown (USA). Dept. of Geology). 1978. Contract EY-76-S-05-5065. 49p. Dep. NTIS, PC A03/MF A01.

Drill cores are analyzed and used to develop maps, especially of the Waynesburg and Pittsburgh deposits, showing stratigraphy, seam thickness, sulfur composition changes, etc. The results are used to interpret conditions during the formation of the deposits and compared with presently existive peat swamps. (LTN)

5322 (UNIDO/EX—36) **Working paper for the Working Group Meeting on Coking Coal.** (United Nations Industrial Development Organization, Vienna (Austria)). 24 Feb 1978. 19p. (CONF-7804162—1). United Nations Industrial Development Organization, New York, NY.

From Working group meeting on coking coal; Vienna, Austria (6 Apr 1978).

The Report of the First Consultation Meeting held in Vienna from 7 to 11 February 1977 recommended that the UNIDO Secretariat should examine the following topics so that it could make specific proposals to the next consultation meeting concerning ways of promoting international co-operation to ensure the availability of the raw materials and fuels needed for the expansion of the iron and steel industry: a review of known reserves of coking coal and the identification of probable resources; a review of the plans and progress made in developed and developing countries to increase the production of those raw materials and consideration of whether appropriate measures were being taken to ensure an adequate supply of them; and a survey of the alternative techniques including sponge iron that might be used to replace coking coal by other fuels and reductants, including processes for the gasification of coal, and the use of formed coke or charcoal, taking into account the returns from alternative uses of those raw materials. Information on these topics is presented. (LTN)

5323 **Remaining strippable coal resources and strippable reserve base of the Hanna Coal Field in southcentral Wyoming.** Glass, G.B.; Roberts, J.T. Laramie, WY; Geological Survey of Wyoming (1979). 169p. (NP—24017). Geological Survey of Wyoming, Laramie, WY.

It is estimated that 674.31 million tons of strippable coal resources remain in four newly defined mining districts of the Hanna Coal Field in southcentral Wyoming. Of these strippable resources, 46% or 309.97 million tons lie between 0 to 100 feet of cover while the other 54% or 364.34 million tons lie between 100 to 200 feet of cover. The remaining strippable reserve base or that part of the strippable resources from which strippable reserves are derived, is reduced to 648.29 million tons (96% of strippable resources). Forty-six percent or 297.12 million tons of the reserve base occur under less than 100 feet of cover while the remaining 351.17 million tons occur under thicker cover (100 to 200 feet thick). Although strippable reserves per se (recoverable reserves) were not estimated, a fair approximation is that strippable reserves equal at least 80% of the reserve base between 0 to 100 feet deep or 237.7 million tons. Although some percentage of the reserve base between 100 to 200 feet deep is also recoverable, the percentage is harder to estimate. Applying the same rule of thumb that strippable reserves may equal 80% of that tonnage as well, another 280.94 million tons of reserves is identified for a total of 518.64 million tons of strippable reserves in the Hanna Coal Field. A more conservative appraisal of strippable reserves in the 100 to 200 feet depth range is half the reserve base or 175.59 million tons, thus reducing the remaining reserves to 413.29 million tons. With the exception of 9.44 million tons of strippable bituminous resources in the 0 to 100 feet overburden category and another 6.65 million tons in the 100 to 200 feet overburden category, all the strippable resources and strippable reserve base in the Hanna Coal Field are of subbituminous rank.

MINING

REFER ALSO TO CITATION(S) 5343, 6080

5324 (CONF-790894—1) **Design of longwall mining system.** Curth, E.A. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Mining Technology Center). 1979. 46p. Dep. NTIS, PC A03/MF A01.

From 1. conference on ground control problems in the Illinois coal basin; Carbondale, IL, USA (22 Aug 1979).

A premining investigation includes core drill holes, seismic studies, satellite imagery and, where the underground is accessible, bearing strength tests of roof and floor, and residual stress determination. Longwall retreat is the preferred method in the USA. Exceptions are few. The objective of panel design is to maintain ground stability and to provide optimum resource recovery with the most cost-effective panel configuration. Environmental considerations, such as surface utilization, hydrology, oil and gas wells, affect panel location and layout. Roof support selection criteria stem from premining data. Prototype roof supports must satisfy an intensive testing program. Mining equipment, such as cutter loaders, face conveyors and stage loaders, is designed to match the production goal and anticipated face conditions. Coal clearance, power supply, men and supply transportation, communications, and equipment maintenance programs must be commensurate with the extraction potential. Face lighting must comply with mandatory standards. Operational monitoring and analysis include operational data extracted and summarized from shift and monthly records, and from ground control and subsidence observations.

5325 (CONF-7905124—1) **Distribution of selected transition and heavy metals in clastic overburden units of the Appalachian and Interior Coal Basins: water quality implications.** Bogner, J.E.; Sobek, A.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 38p. Dep. NTIS, PC A03/MF A01.

From 9. international congress of carboniferous stratigraphy and geology; Urbana, IL, USA (19 May 1979).

As part of a study to investigate possible sources of transition and heavy metals transported in coal mine drainage, overburden

lithologies from 18 surface mines in the Appalachian and Interior Basins were sampled and analyzed for total chemistry. The mines were widely scattered geographically so that samples could be obtained of as many representative lithologies as possible. Overburden units were predominantly Pennsylvanian basin margin clastics, with some Pennsylvanian carbonates and Pleistocene sediments in the Interior Basin. Based on lithologic descriptions, relative percentages of silicon and aluminum, and gross mineralogy from semiquantitative x-ray diffraction, the average metals concentrations for overburden units were developed for two major lithologic groups: (1) quartz-rich units, including sandstones, siltstones, and silts; and (2) clay-rich units, including shales, claystones, clays and tills. Comparing the regional averages for this study with published averages for the coals of the two regions, the highest average concentrations of most metals occurred in the fine-grained (clay-rich) units of the two regions; exceptions were chromium, strontium, and lead in Interior Basin quartz-rich units; and zinc and sulfur in Interior Basin coals. Manganese concentrations were elevated in the quartz-rich units of both regions. In general, the Interior Basin quartz-rich units and coals contained high average concentrations of iron and sulfur; however, substantial quantities of neutralizers (reflected in high average calcium content and high neutralization potential) were also present in the Interior Basin clastics.

5326 (IR—1101) **Guide to geologic features affecting coal mine roof.** Stahl, R.L. (Department of Labor, Washington, DC (USA)). 1979. 18p. Department of Labor, Arlington, VA.

Geologic features including concretions, clay veins, faults, fossils, channel sandstones, and rolls (all defined in the appendix) can signal hazardous roof conditions in underground coal mines. This guide is designed to be used by mine personnel as a quick reference to aid in recognizing these geologic hazards. If a geologic hazard is recognized in time appropriate corrective measures can be taken, thus reducing the likelihood of roof fall accidents and injuries. Visual inspection is an important aspect of roof control.

5327 (SAND—79-2151) **Fossil energy subsidence program. First progress report, May-September, 1979.** Northrop, D.A. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 26p. Dep. NTIS, PC A03/MF A01.

This report summarizes progress during the initial months of a Fossil Energy Subsidence Program supported by the US Department of Energy through its Carbondale Mining Technology Center. The program is a joint effort with Los Alamos Scientific Laboratory directed towards the prediction, and ultimately control, of effects due to subsidence caused by the underground mining of coal and other fossil energy resources. The Sandia work focuses upon the near-field effects at the mining horizon and propagation of the subsidence to the ground surface. Work accomplished in several areas is described. Two numerical schemes are being used for simulation of subsidence: one incorporates an analytical model of roof failure and buckling into the explicit finite element code, HONDO, and the other uses an elastic, brittle-fracture constitutive model into a finite element code. An extensive survey of on-going subsidence research in the US has been conducted with LASL and CMTC which have included numerous trips and discussions. Aid has been provided to CMTC in the development of an overall Subsidence Research and Development Program Plan.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 5232, 5233, 5824

5328 (CONF-791014—, pp III.22-III.25) **Wear resistant alloys for coal handling equipment.** Zackay, V.F.; Parker, E.R. (Univ. of California, Berkeley). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5329 (DOE/EIA/8596—T1) **Capital requirements for the transportation of energy materials: 1979 ARC estimates. Final report.** (TERA, Inc., Arlington, VA (USA)). 28 Sep 1979. Contract EM-77-C-01-8596. 144p. Dep. NTIS, PC A07/MF A01.

TERA's estimates of capital requirements to transport natural gas, crude oil, petroleum products, and coal in the US by 1990 are presented. It is a continuation of a 1978 study (EAPA 5:3946) to perform a similar analysis on 1979 scenarios. Scenarios B, C, and D from the EIA's Mid-range Energy Forecasting Systems, as used in the 1979 Annual Report to Congress (ARC), were provided as a basis for the analysis and represent three alternative futures. Summaries of transportation investment requirements through 1990 are given for Scenarios B, C, and D. Total investment requirements for the three models (pipelines, railroads, waterways) and the three energy commodities (coal, petroleum, petroleum products, natural gas) are estimated to range between $35.3 and $42.7 billion by 1990 depending on the scenario.

5330 (FE—2707-T1(Vol.1)) **Coal and gas pipeline feasibility study. Volume I. Executive summary report.** (Systems Consultants, Inc., Washington, DC (USA); West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering; Williams Bros. Engineering Co., Tulsa, OK (USA)). Oct 1978. Contract EF-77-C-01-2707. 25p. Dep. NTIS, PC A02/MF A01.

This study in 3 volumes concerns three sequential coal processing operations: beneficiation, gasification, and transportation. In the final step, clean coal is transported pneumatically by means of a fuel gas stream produced during gasification. The three processes are a means of providing clean, reasonably priced fuels to the major demand areas of the United States. Three benefication techniques were considered, dry air table cleaning, wet deep cleaning through heavy media cyclone and floatation cell systems, and a conceptual air classification/screening system. The BI-GAS process was the coal gasification process considered. This process produces a fuel gas of 450 Btu/SCF. A pneumatic transport system was devised for long distance (300 miles) transport of beneficiated coal and clean fuel gas. The system was analyzed for various pipe diameters, flow rates, coal particle sizes, coal to gas mass ratios, and operating pressures. A representative end of pipeline fuel cost of $2 to $4 per million Btu was predicted by this study. Alternative modes of transport also were considered for comparison with pneumatic transport. They were unit train and slurry pipeline systems. An economic systems analysis was developed and transport tariffs of all the systems obtained. This study indicates that the clean coal and gas fuel mixture can be delivered to the Philadelphia-Wilmington area from West Virginia (300 miles) at 20 year average costs of from $2.10 to $3.60 per MMBtu if the product gas is used to transport the beneficiated coal and the raw coal is available at the mine mouth for $10.00 to $25.00 per ton, respectively.

5331 (FE—2707-T1(Vol.2)) **Coal and gas pipeline feasibility study. Volume II. Technical & economic evaluation.** (Systems Consultants, Inc., Washington, DC (USA); West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering; Williams Bros. Engineering Co., Tulsa, OK (USA)). Oct 1978. Contract EF-77-C-01-2707. 122p. Dep. NTIS, PC A06/MF A01.

5332 (FE—2707-T1(Vol.3)) **Coal and gas pipeline feasibility study. Volume III. Appendices.** (Systems Consultants, Inc., Washington, DC (USA); West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering; Williams Bros. Engineering Co., Tulsa, OK (USA)). Oct 1978. Contract EF-77-C-01-2707. 215p. Dep. NTIS, PC A10/MF A01.

COMBUSTION

REFER ALSO TO CITATION(S) 5243, 5674, 5681, 5689, 5877, 6105, 6106, 6107, 6108, 6109, 6110, 6111, 6112

5333 (CONF-790822—16) **Laboratory studies of trace element transformations during coal combustion.** Mims, C.A.; Neville, M.; Quann, R.J.; Sarofim, A.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1979. Contract EX-76-C-01-2215. 29p. Dep. NTIS, PC A03/MF A01.

From 87. AICHE national meeting; Boston, MA, USA (19 Aug 1979).

Small-scale coal combustion experiments under well controlled conditions have been used to study the transformation of mineral constituents during combustion. Vaporization rates of various elements from well characterized coal samples have been measured over wide ranges of temperature and gas composition. The implication of these data for modelling the fate of mineral matter is discussed.

5334 (CONF-791014—, pp 32-60) **Material design requirements for coal combustion.** Sims, C.T. (General Electric Co., Schenectady, NY). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

Coal-derived fuels, including directly combusted coal, coal-derived liquids, and coal-derived gases possess potential to cause damage to gas turbine hot stage parts and to heat exchangers in contact with the fuel combustion products. Proper production and effective cleaning of the fuels and gas streams is mandatory to preclude occurrence of corrosion, erosion and fouling. Advanced air-cooled turbine designs and water-cooled designs as well as heat exchangers require cooled materials to operate in gas streams at higher temperatures than ever, creating sharp thermal gradients. These can generate a significant materials problem. Fuel specifications existing for gases and petroleum-based fuels, while helpful as guides for coal and coal-derived fuels, ultimately will require revision. For example, Na and K can no longer be considered equivalent with respect to corrosion damage. Reduced availability and increased cost of the nonferrous element utilized in high-performance alloys will be intermittent nagging problems; work is essential to

develop alloys with less strategic element content. Productive basic and applied research involving the university-type atmosphere with integration/leadership by industry is needed in the following areas: improved alloy protection, activity to understand details of advanced processing, greater strength and fatigue behavior, developments of composite superalloys structures, development of corrosion - resistant TBC's, and weldable/joinable heat exchanger alloys with greater creep resistance.

5335 (CONF-791014—, pp V.26-V.27) **Task 3: gas turbine technology of the coal fired combined cycle development program.** Beltran, A.M.; Grey, D.A. (General Electric Co., Schenectady, NY). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5336 (EPRI-AF—1144) **300 Btu gas combustor development program. Phase I. Final report, August 1979.** Baillif, B.N.; Boenig, F.H.; Grant, J.R.; Holladay, T.E. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.; Pratt and Whitney Aircraft Group, West Palm Beach, FL (USA). Government Products Div.). 1979. 100p. Dep. NTIS, PC A05/MF A01.

Industrial turbines fired on medium heating value (MHV) gas (nominally 300 Btu/scf) synthesized from coal offer an attractive alternative means of producing electrical power in the future. Peak flame temperatures resulting from combustion of this MHV gas in conventional diffusion flame combustors may be comparable to those of natural gas, yielding undesirably high concentrations of NO/sub x/. The purpose of this program was to demonstrate a MHV gas turbine combustor capable of meeting Environmental Protection Agency (EPA) NO/sub x/ requirements without water injection. Program objectives were to design, fabricate, and test three MHV combustor configurations and to demonstrate NO/sub x/ emissions concentrations of 15 ppmv (dry basis) or less at a burner inlet pressure of 1.27 atms. The program goal of 15 ppmv corresponds to approximately 55 ppmv at engine pressures. Current EPA requirements are 75 ppmv. Design of the combustors was based on a lean-premix concept. By premixing fuel and air in lean proportions prior to combustion, flame temperatures, and thus NO/sub x/ formation, were controlled. Tests were conducted in a single-can combustor rig at simulated engine conditions ranging from 40 to 125% of engine baseload (74 MW). Measured data included inlet and exit temperatures, pressures, and emissions of NO/sub x/, CO, CO_2, O_2 and total (unburned) hydrocarbons. A conventional diffusion flame burner fired on natural gas was also tested to obtain baseline data. NO/sub x/ data were corrected to standard conditions as per EPA requirements for inlet pressure, percent O_2, and specific humidity. Rig data were analyzed to obtain performance parameters of combustion efficiency, burner pressure loss, and exit temperature pattern factor. Results show that all three combustors meet the NO/sub x/ goal, with corrected concentrations of 12 ppmv or less over the range of test conditions.

5337 (FE—2689-8) **Investigation of fuels containing coal-oil-water emulsions: fire tube test apparatus design and construction. Eighth quarterly report, 1 July 1979 to 30 September 1979.** Cherry, N.H.; Stokes, C.S. (Germantown Labs., Inc., Philadelphia, PA (USA)). Oct 1979. Contract EF-77-C-01-2689. 10p. Dep. NTIS, PC A02/MF A01.

The design and construction of a fire tube test apparatus for the burning of coal-oil-water emulsions has been set up. The unit is instrumented as to temperatures and flows along with a stack gas analyzer. Preliminary firings have been made to identify problem areas. Chemical analysis of the base fuel, base coal, and typical COM have been made.

5338 (FE—3402-T1) **Coal combustion by wet oxidation. Wet oxidation of coal for energy production: a literature review through December 1978. Interim report.** Lamparter, R. (Michigan Technological Univ., Houghton (USA). Center for Waste Management Programs). 1 Jun 1979. Contract ET-78-G-01-3402. 63p. Dep. NTIS, PC A04/MF A01.

Use of the wet oxidation process for energy production is only rarely cost competitive with conventional combustion techniques. One exception is the wet oxidation of organic material such as peat or sewage sludge which has a high water content. A second possible case is the wet oxidation of tailings from coal physical cleaning processes. These tailings have high pyritic sulfur content as well as high ash content and cannot be economically burned by conventional techniques. Studies performed by Ames, PERC, Ledgemont, and Zimpro indicate that wet oxidation may be used to remove in excess of 98% pyritic sulfur and 45% organic sulfur from coal. Partial wet oxidation of coal for the purpose of sulfur removal appears to be economically feasible; however, most studies have been performed in 1-liter batch reactors. Whether reactions run with air or oxygen will be most economical appears to be a function of the location and size of the wet oxidation plant. Since oxygen is expensive to manufacture, but air must utilize higher system pressures, there is a trade-off between the cost of buying or manufacturing oxygen and the expense associated with pumping air to higher pressures. In summary, considerable work remains to be done in evaluating the chemical and economical aspects for energy production from carbonaceous fuel sources by wet oxidation.

5339 (METC/RI—79/7) **Surface chemistry of aluminosilicate particles: application to combustion stream chemistry.** Stinespring, C.D.; Stewart, G.W. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Aug 1979. 32p. Dep. NTIS, PC A03/MF A01.

It has been observed that the surface of heated illite is enriched in iron, potassium, calcium, and sulfur. Specifically, potassium, calcium, and sulfur reside in the outermost atomic layers of the iron-enriched aluminosilicate surface. The temperature dependence of this thermally-induced surface enrichment has been characterized for temperatures in the range of 150° to 1100° and heating periods on the order of twelve hours. Bulk depletion and desorption of potassium and sulfur have also been observed. The results can be qualitatively understood in terms of surface segregation. Having observed that the thermodynamics of surface enrichment are favorable, it is clear that the rates of enrichment are needed to further define the role of surface enrichment in the surface chemistry of the entrained or deposited aluminosilicate ash particles. In addition, the rates of desorption and adsorption for potassium and sulfur species are required to assess the extent of the release of these species into the combustion stream. The experimental results and the physical considerations included in the physical model indicate that, irrespective of the rates of surface enrichment, gas-surface reactions involving aluminosilicate and enriched aluminosilicate surfaces are of importance. Although a number of important gas-surface reactions may occur on these surfaces, those of greatest interest involve the formation, transport, or removal of corrosive species and atmospheric pollutants.

5340 (ORNL—5569) **Technology assessment for an atmospheric fluidized-bed combustion demonstration plant.** Siman-Tov, M.; Bradley, N.C.; DeCicco, S.G.; Fox, E.C.; Godfrey, T.G.; Holcomb, R.S.; Kuhlmann, R.E.; Lackey, M.E.; Mitchell, H.A. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 208p. Dep. NTIS, PC A10/MF A01.

The status of atmospheric fluidized-bed combustion (AFBC) technology was examined and, in particular, the data base available for successful design, construction, and operation of an AFBC demonstration plant of 150 to 250 MW(e) capacity. The basic conclusion is that no insurmountable problem areas exist which would prevent demonstration of the basic feasibility of the technology and its acceptability from environmental and safety viewpoints at the 150 to 250 MW(e) scale. There are, however, some areas of concern and a number of development needs; the most important of these are (1) solids feeding and distribution systems, (2) system operation and control, (3) materials compatibility and corrosion/erosion, (4) bed performance and combustion efficiency, (5) environmental issues and solid waste disposal, (6) system simulation and predictive data base, and (7) system reliability and safety. The first two items are most critical, and delay in finding practical solutions may affect the success of the demonstration plant project: the third item may fall potentially into the same category since there are no long-term materials data. A research and development program aimed at early resolution of these problems should be carried. A facility designed to investigate feeding problems should be constructed. A materials test facility with several flexible beds is also needed. An intermediate-size pilot plant with sufficient flexibility to test alternate solutions to operating and technical problems would considerably strengthen the demonstration program. A practical approach to fuel feeding and development of an acceptable control and operation strategy appear to be necessary for success of the program.

5341 **Combustion of hot gases of low calorific power.** Deruelle, J. (to Stein Industrie). US Patent 4,113,417. 12 Sep 1978. Priority date 6 Nov 1974, France, 6p.

The complete combustion of hot gases of low calorific power is effected by introducing the gases into a combustion chamber at a pressure close to atmospheric pressure and at a temperature of between 600 and 900°C, by introducing at burner level primary air to a maximum of 80% of the stoichiometric proportion, by supplying secondary air near the base of the flame in an excess relation to the stoichiometric amount so that the flame temperature is between 1000 and 1300°C and by discharging the combustion products from the combustion chamber by means of a chimney. 8 claims.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 5691

5342 (DOE/EIA/8606—1) **Impact of petroleum industry horizontal divestiture on the coal market.** Zimmerman, D.L.; Dymond, L.H.; Marris, R.L. (Synergy, Inc., Washington, DC (USA)). 22 Jun

1979. Contract EM-77-C-01-8606. 152p. Dep. NTIS, PC A08/MF A01.

The US Congress has set forth proposals which would prohibit oil companies from acquiring coal companies or other nonpetroleum energy resources. Some proposals would require oil companies to divest themselves of any such resources that they already hold. The first legislation was introduced on this topic in the 94th Congress and alternative proposals are under serious consideration at the current time. We have analyzed some major variants of these legislative propsals with a study of likely economic behavior in the coal market as a result of horizontal divestiture. After a thorough study of the theoretical and empirical aspects of ownership-related behavior, two dichotomous sets of assumptions are possible. One set of assumptions is oriented towards synergism and growth maximization. The interpretation of these assumptions in the model is one of a lower rate of return for oil owned coal assets relative to non-oil owned assets. The second set of assumptions could broadly be termed monopoly assumptions. The depiction of these within the model framework is one of higher rates of return for oil owned coal relative to non-oil owned. These results are based on economic theory, engineering and econometric models, and analysis; all set in the general framework of comparative statics. Comparative statics is an analytical tool which permits investigation of a situation before and after government intervention. The models used include the National Coal Model and the Project Independence Evaluation System (PIES) model. These models are well-grounded in economic theory and characterize the coal and energy markets well for analysis purposes. Assumptions and qualifications are detailed. (LTN)

5343 (EPRI-EA—1133) **Analysis of Bechtel's Regional Energy System for Planning and Optimization of National Scenarios (RESPONS), and ICF's National Coal Model (NCM). Final report.** Vogely, W.A. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1979. 144p. Dep. NTIS, PC A07/MF A01.

This project, RP874, analyzed and compared two coal models - the I.C.F. Inc. National Coal Model (NCM) and the Bechtel Regional Energy System for Planning and Optimization of National Scenarios (RESPONS). The NCM is a single-period linear program and data base designed to forecast coal production, consumption, and prices in studies of coal-related public policy issues. RESPONS is a large system of interconnected models used to study energy supply and demand patterns. It includes a single-period linear program coal supply model and an associated data base. In this study, the RESPONS model was run on the Pennslvania State University computer, and both the model and its output were reviewed. The NCM was not run, but its assumptions were analyzed and sample outputs from other sources were reviewed. The conclusion of the project was that the results produced by both models are useful but require careful interpretation. The project report recommends specific modeling methodology and data base improvements for both models to make the coal sector representation more realistic. Some of these improvements would require considerable additional effort.

HEALTH AND SAFETY

5344 (BNL—51037) **Coal-conversion technologies: some health and environmental effects.** Morris, S.C.; Moskowitz, P.D.; Sevian, W.A.; Silberstein, S.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). Feb 1979. Contract EY-76-C-02-0016. 26p. Dep. NTIS, PC A03/MF A01.

Several technologies to convert coal to liquid and gaseous fuels are being developed in the United States, some with support from the Department of Energy. Substitution of these technologies for those currently used will produce different health and environmental damages. In this paper, selected health and environmental concerns of four coal-conversion and four existing technologies are compared. For each technology, emission estimates for complete fuel cycles, including all steps in fuel use from extraction to end use of space and water heating via electricity or direct combustion, were prepared using the Brookhaven Energy System Network Simulator model. Quantitative occupational health and safety estimates are presented, covering extraction, transportation, distribution, processing, and conversion activities; also included are estimates of public health damage arising from fuel transportation and air pollution impacts. Qualitative estimates of health damage due to polycyclic organic matter (POM) and reduced sulfur are discussed. In general, energy inefficiencies, residuals, and hence implied environmental and health damages increase as follows: (1) direct combustion of natural gas and oil; (2) direct combustion of synthetic gas and oil; (3) central-station electric power from synthetic gas; (4) central-station electric power from coal; (5) central-station electric power from combustion of synthetic liquid fuels. Compliance and conflict of these technologies with Clean Air Act Amendments and other legislation are discussed.

5345 (PNL—3189) **Biomedical studies on solvent refined coal (SRC-II) liquefaction materials: a status report.** (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 64p. Dep. NTIS, PC A04/MF A01.

This technical report summarizes the results of biomedical research effort on solvent refined coal (SRC) materials. The samples, described in the text, as well as samples of raw shale oil, crude petroleum, and some SRC-I materials were evaluated for biological activity in several different systems: (1) microbial mutagenesis (Ames assay), coupled to chemical characterization efforts, (2) in vitro mammalian cell toxicity and transformation, (3) epidermal carcinogenesis (skin painting) in mice, (4) acute and subchronic oral toxicity in rats, (5) developmental toxicity in rats, and (6) dosimetry and metabolism in rats. High boiling point materials (identified) showed significant mutagenic activity while lower boiling fractions from both processes were inactive; crude petroleum was also inactive, while raw shale oil showed only a low level of activity. Chemical characterization studies suggested that 3- and 4-ring primary aromatic amines are responsible for a large fraction of the mutagenic activity. Cultured mammalian cell studies showed that materials exhibiting a positive effect in the Ames system also caused mammalian cell transformation. The results of skin carcinogenesis studies in the mouse were generally consistent with those of the cellular studies. Light distillates were found to be moderately toxic after oral administration to rats. Fuel upgrading, process modification, and appropriate occupational/environmental controls may ameliorate some of the biological effects of SRC materials and other coal liquids of high boiling point. Low-boiling SRC liquids appear to have little biological effects in the assays employed. (LTN)

PETROLEUM

REFER ALSO TO CITATION(S) 5869, 5891

5346 (NP—24166) **Language of oil. 5th Revised Edition.** (Mineraloelwirtschaftsverband e.V., Hamburg (Germany, F.R.)). Sep 1978. 56p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

In alphabetic order, terms and expressions are listed which come from the field of crude oil and mineral oil products, their availability, marketing, taxing, tariffing, etc., with definitions or explanations.

RESERVES

5347 (DOE/IA—0008) **Report on the petroleum resources of the Federal Republic of Nigeria.** (Department of Energy, Washington, DC (USA). Energy Information Administration; Geological Survey, Washington, DC (USA)). Oct 1979. 141p. Dep. NTIS, PC A07/MF A01.

Nigeria ranks among the top 10 largest oil producers and exporters of the world, with production being as high as 2.4 million bbl/d. Its ultimately recoverable oil resources may range from 20.5 to 41.5 billion bbl, of which 6.1 billion bbl have already been produced through 1977. With accelerated exploration and development. Nigeria's production capacity could reach 3.0 to 3.3 million bbl/d and hold this level for 5 years. Probable production rate, however, is 2 to 2.5 million bbl/d for at least 10 years. Nigeria's natural gas resources are comparatively underdeveloped and underutilized.

GEOLOGY AND EXPLORATION

5348 (INIS-mf—4683) **Theory and experience of tracer technique application for solution of oil prospecting problems.** (Severo-Kavkazskij Nauchno-Issledovatel'skij i Proektnyj Inst. Neftyanoj Promyshlennosti, Groznyj (USSR)). 1977. 53p. (In Russian). (CONF-7705173—(Summ.)). Dep. NTIS (US Sales Only), PC A04/MF A01.

From Regional scientific-technical seminar; Groznyj, USSR (18 May 1977).

Separate abstracts were prepared for individual papers from this seminar. (DLC)

5349 (ORNL/TM—6885) **Data report: resource ratings of the RARE II tracts in the Idaho-Wyoming-Utah and the central Appalachian thrust belts.** Voelker, A.H.; Wedow, H.; Oakes, E.; Scheffler, P.K. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 151p. Dep. NTIS, PC A08/MF A01.

The assessment forms contained in this report constitute the data used in two resource assessments described in A Systematic

Method for Resource Rating with Two Applications to Potential Wilderness Areas (Voelker et al. 1979). The assessments were performed for two geologic subprovinces containing proposed wilderness areas identified in the Forest Service Roadless Area Review and Evaluation (RARE II) program. The subprovinces studied are the Idaho-Wyoming-Utah thrust belt and the central Appalachians thrust belt. Each assessment form contains location data, resource ratings, and supporting information for a single tract. A unique dual rating that reflects geologic favorability and certainty of resource occurrence is assigned to each resource category evaluated. Individual ratings are synthesized into an overall tract-importance rating. Ratings created by others are included for comparative purposes wherever available. Supporting information consists of commentary and references that explain and document the ratings listed.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 5313, 6084

5350 (CONF-790891—1) **Ion exchange on mixed ionic forms of montmorillonite at high ionic strengths.** Rogers, W.J.; Shiao, S.Y.; Meyer, R.E.; Westmoreland, C.G.; Lietzke, M.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

From 3. international conference on surface and colloid chemistry; Stockholm, Sweden (20 Aug 1979).

This paper summarizes studies of the distribution of sodium and calcium ions between a common clay, montmorillonite, as well as several other clays, and a series of solutions of constant total ionic strength (I) with varying ionic strength fraction of sodium. Distribution coefficients D for Na(I) and Ca(II) were determined by batch equilibrations using isotope dilutions with radioactive tracers. Equilibrium quotients (K/Γ) for the exchange of sodium and calcium were then calculated and the effects of solution composition, of solution phase activity coefficients, of ionic strength, of degree of purification, and of source of clay were investigated. Equilibrium quotients with adjustment for solution-phase activity coefficients did not vary greatly with I, except at low loading of sodium on the calcium form of montmorillonite, where D/sub Na/ became anomalously high. Values of K/Γ for illite and attapulgite were within an order of magnitude of those for montmorillonite.

5351 **Rotating blowout preventor with rigid washpipe.** Biffle, M.S. US Patent 4,154,448. 15 May 1979. Filed date 18 Oct 1977. 12p.

A rotating blowout preventor of simplified construction is described which requires no kelly drive bushing, and which has a rotating external housing formed at the upper marginal end thereof within which the main bearings and seals are isolated. The external housing rotates about a fixed washpipe and supports a stripper seal doughnut to which a stripper seal is mounted in underlying relationship thereto. A removal clamp enables the doughnut and stripper rubber to be lifted free of the assembly for service or replacement. The bearing housing is fabricated in a manner to enable servicing the seals and bearings thereof without removing the blowout preventor from the top or a tool string. The bearing housing and seals therefore are arranged respective to the rotating stripper rubber such that should leakage across the stripper rubber and seal occur, the isolated bearing housing will be maintained free of contamination therefrom.

5352 (INIS-mf—4683, pp 39-41) **Experience in application of radon tracer technique for study on technical conditions of wells.** Fershter, A.V.; Antonov, V.N. 1977. (In Russian).

From Regional scientific-technical seminar; Groznyj, USSR (18 May 1977).

Experience in application of radon tracer technique for study on technical conditions of oil wells is described. It is established that radon tracer technique can be successfully used to determine places of column fault and absorption zone, liquid flow direction beyond the tube, cement elevation, presence of hydrofracture elastic cracks and so on. The most valuable results were obtained while determining casing string safety and plugging solution elevation during two-step well cementation in salt-bearing deposits.

5353 (INIS-mf—4683, pp 41-43) **Identification of permeable strata according to the data obtained by radon tracer technique.** Kalinin, V.G.; Romanov, V.V. 1977. (In Russian).

From Regional scientific-technical seminar; Groznyj, USSR (18 May 1977).

The technique of identification of permeable strata in oil well pits is according to the data obtained by radon tracer technique. The identification of permeable strata is made by the increment of anomalous component of gamma field intensity. The technique provides three variants of using radon indicator: drilling of prospect space using washing liquid activated with radon; introduction of labelled solution into strata after their drilling; introduction of activated liquid into well space under study before column lowering. On the basis of 12 well investigations (up to 5300 m depth) the conclusion of high resolution of the method has been made.

5354 (INIS-mf—4683, pp 43-45) **Potential study of bed filtration characteristics in impressed boreholes by radon tracer technique.** Litvinov, A.A.; Pinkenzon, D.B.; Makarov, M.S.; Vinarskii, M.S. 1977. (In Russian).

From Regional scientific-technical seminar; Groznyj, USSR (18 May 1977).

Potential study of bed filtration characteristics in impressed boreholes by radon tracer method is shown. Effects recorded by radon tracer result from gamma radiation of short-living radon decay daughter products. During filtration of tracer through punched holes, cement stone, and rocks the products are deposited and cause a local effect for 2-3 hours. There is a shortage of short-living products in filtrated radon liquid and for some time (which is necessary for production of notable quantity of new decay products) it is practically not a gamma emitter. It is shown that the feature of effect formation governs the technique for well logging as well as interpretation of the results obtained.

5355 (SAND—79-0771C) **Preliminary assessment of solar enhanced oil recovery.** Bergeron, K.D. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-791204—5). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

There are several qualitative reasons why steam EOR may be well suited to solar energy: (1) Sufficient land for the solar power requirements is available, (2) no thermal storage or backup system is required, (3) most of the steam EOR potential is in California, where insolation is high and tolerance of air pollution prohibitively low, (4) the energy form is thermal, at temperatures generally less than 600°F, where most concentrating collector systems can operate relatively effectively. These favorable qualitative features are reflected in the results of a cost model developed for comparing conventional and solar EOR. Included in the analysis are tax effects, O & M costs, salvage values, differential oil price escalation, inflation and discount effects. The reference system for this preliminary study is a field of parabolic troughs, without storage, generating 70% quality steam at 465°F at an average rate of 1.5 MW/sub t/ per injector (about 350 bbl of steam per day). At a cost of $200/m^2, such a system would require an initial investment of $2.5 million per injector. With a 12% discount rate and a solar energy steam system which costs $200/m^2 installed, and with 80% loan financing, the breakeven heavy crude price is $11/bbl. At $300/m^2, the breakeven price is $17/bbl. If project financing is not available, the corresponding prices for equity financing are $24/bbl and $37/bbl, respectively. One problem is how to handle the intermittency of the solar energy input. One possibility is to inject steam intermittently, but increased sanding in the well casing may eliminate this option. Other options discussed are thermal storage, fuel-burning backup, low level steam injection for pressure maintenance, or some combination.

5356 (UCRL—83448) **Explosive-induced damage in porous sandstone.** Kusubov, A.S.; Durham, W.B.; Schock, R.N.; Schatz, J.F.; Ahrens, T.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Terra Tek, Inc., Salt Lake City, UT (USA); California Inst. of Tech., Pasadena (USA)). 10 Oct 1979. Contract W-7405-ENG-48. 8p. (CONF-790709—17). Dep. NTIS, PC A02/MF A01.

From VII international AIRAPT conference; La Creusot, France (30 Jul 1979).

A combined laboratory and computational effort was conducted to study the effect of overburden pressures on explosively damaged porous sandstone. It was found that it was difficult to establish a dependence on confining pressure. The predominant effect of the explosion was compaction around the cavity, and macroscopic fractures were conspicuously absent.

5357 **Well pressure test plug.** Koleilat, B.M. (to FMC Corp.). US Patent 4,121,660. 24 Oct 1978. Filed date 22 Aug 1977. 8p.

A test plug is described for use in pressure testing a Christmas tree and blowout preventer atop an oil or gas wellhead. The test plug includes a cylindrical body having an outer diameter slightly smaller than the bore of the wellhead, and a plurality of support dogs that fit into an annular groove in the wellhead to support the plug during pressure testing. The plug is landed on a relatively narrow shoulder in the bore of the wellhead and the dogs are then extended into the groove by vertical movement of a mandrel, thereby lifting the plug off the shoulder and securely supporting it in test position. 8 claims.

5358 **Oil recovery and mobility control using succinate surfactant systems.** Valcho, J.J.; Karll, R.E. (to Standard Oil Co.). US Patent 4,122,020. 24 Oct 1978. Filed date 25 Aug 1977. 12p.

A method is disclosed for moving and eventually recovering oil from a subterranean oil-bearing formation which comprises injecting into the formation an aqueous fluid containing a succinamate

surface-active agent and method for mobility control (imparting viscosity) to a surfactant system used for recovery or moving of oil in an oil-bearing formation. 27 claims.

5359 Power source for subsea oil wells. Dixon, W.P. US Patent 4,112,687. 12 Sep 1978. Filed date 16 Sep 1975. 8p.

Disclosed are methods and apparatus for generating electric and hydraulic power adjacent an undersea oil well for use in operating the well-head equipment. The difference in the temperature of the oil being extracted from the well and the temperature of the surrounding sea water is utilized to generate such power. 8 claims.

5360 Asphaltenes as sacrificial agents in oil recovery processes. Ledoux, W.A.; Schoen, W.; Kumar, A. (to Texaco Inc.). US Patent 4,113,013. 12 Sep 1978. Filed date 4 Nov 1976. 6p.

A process for producing petroleum from subterranean formations is disclosed wherein production from the formation is obtained by driving a fluid from an injection well to a production well. The process involves injecting into the formation via the injection well asphaltenes as sacrificial agents to inhibit the deposition of chemical recovery agents such as surfactant on the reservoir matrix. Normally the process would be carried out by first injecting the asphaltenes into the formation through the injection well and following them with a chemical recovery agent. The chemical recovery agent would then be followed by a drive fluid such as water to push the materials to the production well. 4 claims.

PROCESSING

5361 Lowering sulfur oxide output from catalyst regeneration. Blanton, W.A. Jr.; Blakely, D.W. (to Chevron Research Co,.). US Patent 4,165,275. 21 Aug 1979. Filed date 16 Dec 1977. 12p.

Sulfur oxides in flue gas formed during cracking catalyst generation are reacted with a zeolitic crystalline aluminosilicate containing sodium cations in the catalyst generator to form a sulfur-containing solid, and the sulfur component is removed from the crystalline aluminosilicate in the cracking reactor by contacting the sulfur-containing solid with the hydrocarbon feed.

5362 Method of removing sulfur-containing impurities from hydrocarbons. Mulaskey, B.F. (to Chevron Research Co.). US Patent 4,113,606. 12 Sep 1978. Filed date 28 Sep 1976. 6p.

Sulfur-containing impurities are removed from a refined hydrocarbon feed by contact thereof with a porous sulfur-reactive agent having a pore volume of at least 0.15 cm^3/cm^3 of which at least 5% is in pores having a diameter in the range 0.1 to 15 microns. The agent contains at least one sulfur-reactive material from the group copper, iron, zinc, and compounds thereof. 7 claims.

5363 Hydrocarbon conversion with gravity-flowing catalyst particles. Herning, J.G.; Shelton, J.B. (to UOP Inc.). US Patent 4,110,197. 29 Aug 1978. Filed date 12 May 1977. 14p.

A multiple-stage catalytic conversion system is described in which a hydrocarbonaceous charge stock and hydrogen flow serially through a plurality of catalytic reaction zones in each of which the catalyst particles are movable via gravity-flow. The reaction product effluent from each zone, in admixture with added hydrogen is heated prior to the introduction therefrom into the succeeding reaction zone. The proportions of added hydrogen (portions of a recycled hydrogen-rich phase) are such that (1) vapor density decreases, and (2) lateral pressure drop across the catalyst bed increases in the direction of reactant stream flow through the plurality of reaction zones. The disclosed technique alleviates problems associated with the occurrence of stagnant catalyst areas as a result of catalyst particles being pinned within the reaction zone and thus unable to assume a downward gravity-flow pattern. In addition, the technique allows utilization of excess heater capacities before and between reaction zones. 10 claims.

PRODUCTS AND BY-PRODUCTS

5364 Process for the removal of thiols from hydrocarbon oils. Jacobson, R.L.; Gibson, K.R. (to Chevron Research Co.). US Patent 4,163,708. 7 Aug 1979. Filed date 3 Apr 1978. 8p.

Thiol impurities are removed from hydrocarbon oils by contacting the oil with a scavenger at a temperature in the range of about 120° to 400°C. The scavenger is a composite having a copper component and an inorganic porous carrier component and having a surface area in the range 20 to 1000 square meters per pram. The contacting must be with the scavenger below its thiol-sulfur end point.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5344, 5345

MARKETING AND ECONOMICS

5365 (NTISUB/E—286) International energy statistical review, 1979. (Central Intelligence Agency, Washington, DC (USA)). 1979. aprox. 13 issuep. Central Intelligence Agency, Washington, DC (USA).

The International Energy Statistical Review products current information and comparisons with recent years for a variety of topics on international energy; almost all concern some aspect of the petroleum and natural gas industries. Topic areas cover production capacity, production, reserves, trade, consumption, and stocks.

5366 (NTISUB/E—286-002) International energy statistical review. (Central Intelligence Agency, Washington, DC (USA)). 7 Feb 1979. 41p. Central Intelligence Agency, Washington, DC (USA).

The International Energy Statistical Review provides current information and comparisons with recent years for a variety of topics on international energy; almost all concern some aspect of the petroleum and natural gas industries. Six charts deal respectively with total Free World oil production, OAPEC oil production, non-Arab oil production, Free World and USSR oil production, inland oil consumption, and net oil imports. In general, the time period covers the last four or five years. The remainder of the Review is made up of 31 tables, covering such disparate topics as production, capacity, reserves, trade, consumption, and stocks. Areas covered include the world, Free World, OPEC, OAPEC, OECD, selected developed countries, Western Europe, China, USSR, and Eastern Europe.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5379

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5361, 6254

5367 (FWS/OBS—79/23) Ecological and physiological/toxicological effects of petroleum on aquatic birds: a summary of research activities FY 76 through FY 78. Stickel, L.F.; Dieter, M.P. (Patuxent Wildlife Research Center, Laurel, MD (USA)). Jul 1979. 18p. NTIS, PC A01/MF A01.

The physiological and ecological effects of oil on waterbirds were examined in a series of laboratory and field experiments, including studies of the effects of oiling on hatchability of eggs; the effects of an oil-contaminated diet on physiological condition, reproduction, and survival; and the accumulation of oil in body tissues. Chemical methodology was developed in support of these studies.

5368 (SAN—12093-1) Adequacy analysis of air quality monitoring activities relevant to California thermal enhanced oil recovery fields. Matthews, J.; Thomasian, J. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Nov 1979. Contract ET-78-C-01-3092. 139p. Dep. NTIS, PC A07/MF A01.

Section 1 summarizes the purpose of the report, describes briefly EOR activities in California, and presents the conclusions and recommendations derived from this analysis. Section 2 describes the general purpose and requirements behind ambient air monitoring, particularly with regard to State and Federal regulations. In addition, this section discusses ambient air quality monitoring in California and highlights specific monitoring requirements for new source permit regulations. Section 3 discusses the inventory of California EOR air quality monitoring activity contained in Appendix A. Section 4 discusses the present and future adequacy of air monitoring activity in the California EOR fields with regard to several criteria.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 5342

5369 (DOE/RA—0039) Strategic Petroleum Reserve Plan. Distribution Plan for the Strategic Petroleum Reserve. Amendment No. 3. Energy Action DOE No. 5. (Department of Energy, Washington, DC (USA). Office of Resource Applications). Oct 1979. 80p. Dep. NTIS, PC A05/MF A01.

Purpose of this Strategic Petroleum Reserve (SPR) Plan Amendment is to provide a Distribution Plan, setting forth the method of drawdown and distribution of the Reserve. Chapter VII of the SPR Plan contained a Distribution Plan which identified and discussed the major objectives, criteria and other factors that will be considered in developing the detailed plan. This Amendment replaces Chapter VII of the SPR Plan in its entirety.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 5329, 5824

5370 (FE—6434-T2) **Determination of functional and data requirements for pipeline information. Final report on Task No. 2.** (Ideamatics, Inc., Washington, DC (USA)). 16 Feb 1979. Contract EI-78-C-01-6434. 60p. Dep. NTIS, PC A04/MF A01.

This report describes the data needs of the DOE in the Pipeline area and how those needs are fulfilled by the information gathered on Form P. Chapter I provides an introduction to the methodology used in preparing the report, and background statements on Form P and on oil pipeline data. Chapter II defines the functional requirements of organizations/agencies which use pipeline information; Chapter III presents the data requirements for these same agencies; Chapter IV discusses publication and formats for Form P data; and Chapter V summarizes conclusions and recommendations.

PROPERTIES

REFER ALSO TO CITATION(S) 6039

5371 (BETC—0012-1) **Composition and octane number of US motor gasolines sampled in the DuPont 1978-1979 winter road octane survey.** Johnson, W.L. (Du Pont de Nemours (E.I.) and Co., Wilmington, DE (USA)). Sep 1979. Contract EW-78-C-19-0012. 39p. Dep. NTIS, PC A03/MF A01.

Samples of US Motor Gasoline obtained from service stations in early December, 1978, were composited by region based on company sales. These composited samples were analyzed for hydrocarbon composition, sulfur, manganese, other specifications (distillation, RVP, gum, gravity) and Research and Motor Octane Number.

STORAGE

REFER ALSO TO CITATION(S) 5369

5372 (SAND—79-2031C) **Geomechanics investigations of SPR crude oil storage caverns.** Tillerson, J.R. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 35p. (CONF-791095—1). Dep. NTIS, PC A03/MF A01.

From SMRI fall meeting; Toronto, Canada (Oct 1979).

Geomechanics investigations were performed to evaluate existing solution mined caverns in Gulf Coast salt domes being used (or readied) for crude oil storage in the United States Strategic Petroleum Reserve (SPR) program. The geometry and location of the existing caverns is described. A generic study of interaction effects between adjacent caverns identifies cavern spacings for which consideration of operating conditions or product storage limitations might warrant site specific evaluation. Predicted creep closure rates for cavern No. 6 at the West Hackberry, Louisiana, site are shown to bound the measured wellhead data. The creep laws utilized in this simulation are also shown to bound the response of salt cores from West Hackberry as measured in a suite of laboratory tests. Ongoing efforts in and field data needed for evaluating depressurization effects, cavern spacing effects, and salt creep rates are described.

COMBUSTION

REFER ALSO TO CITATION(S) 5337

NATURAL GAS

REFER ALSO TO CITATION(S) 5869, 5891

RESERVES

REFER ALSO TO CITATION(S) 5347

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 5349

5373 (BM-IC—8807) **Helium in ground water and soil gas in the vicinity of Bush Dome reservoir, Cliffside Field, Potter County, Texas. Information Circular 8807.** Holland, P.W.; Emerson, D.E. (Bureau of Mines, Amarillo, TX (USA)). 1979. 25p. Bureau of Mines, Pittsburgh, PA.

This report discusses results of three independent reconnaissance geochemical surveys conducted in the vicinity of the Bush Dome reservoir in the Bureau-owned Cliffside field near Amarillo, Tex. The surveys consisted of determining the helium content of area ground waters, of area soil gases and ground waters, and of soil gases collected on a grid sampling pattern in the Cliffside field area. The native natural gas in the Cliffside field contains about 1.8% helium. To date, approximately 54 billion cubic feet of gas containing approximately 39 billion cubic feet of helium has been injected into the center of the Bush Dome structure. Research work was done to determine if helium concentration levels in ground water and soil gas could be used as an indication of the presence of helium in a subsurface natural gas accumulation. Results of the surveys were positive in that helium-in-water and helium-in-soil-gas anomalies were detected in portions of the Cliffside field area. All helium analyses were performed by mass spectrometric techniques.

5374 **Geophysical exploration of coal and gas resources associated with a buried Triassic basin in the N.C. coastal plains.** Won, I.J.; Leith, C.J. Raleigh, NC; North Carolina State Univ. (1979). 17p. (NP—24167).

A comprehensive field geophysical study was conducted in an area including Lenoir, Jones, and Craven counties in the coastal plains of North Carolina in order to determine the subsurface geological features and favorability of any hydrocarbon occurrence thereof. The study employed an integrated approach using gravity, aeromagnetic, and electrical sounding methods combined with three shallow test holes drilled by the State of North Carolina during the study. Results are negative: the Graingers Basin originally suggested from the aeromagnetic data is now believed to be of Paleozoic age rather than the initially assumed Triassic age. The basement structure, originally inferred from gravity data, is re-interpreted to match the top of phyllite in the light of drill hold data. Although electrical sounding data in the area suggest that the crystalline basement is much deeper than the phyllite basement, the intervening formations are most likely of metamorphosed Paleozoic sediments similar to the slate-belt type rocks, having little chance of containing any hydrocarbon materials. The study has revealed another possibly more promising basin structure between New Bern and Havelock. The data thus far show that the basin may be much deeper than the Graingers basin.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 5351, 5356, 5357, 6084

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5344

MARKETING AND ECONOMICS

5375 (CONF-781259—1) **World trade in liquefied natural gas.** Anderson, P.J.; Daniels, E.J. (Institute of Gas Technology, Chicago, IL (USA)). 1978. Contract EW-78-C-19-0042. 29p. Dep. NTIS, PC A03/MF A01.

From Conference on energy and Southeast Asia; Singapore, Singapore (4 Dec 1978).

Descriptions of LNG projects make it evident that significant activity is continuing on the development of base-load LNG projects to serve all three major gas markets: Europe, Japan, and the United States. These activities have resulted in the development of an international LNG trade of approximately 48.2 billion m^3/y. This represents nearly one-third of the current level of pipeline import/exports of natural gas. By 1982, when all of the projects considered to be firm or under construction are implemented, LNG trade will have grown to a level of 53.7 billion m^3/y. With the implementation of the probable projects by the mid-1980's, this level could increase

to more than 112.55 billion m^3/y. Assuming that the 102.2 billion m^3/y of pipeline import/export projects currently proposed and under construction are implemented in the same period, LNG's relatively more rapid growth will have increased to 48% of the amount of natural gas traded by pipeline.

5376 (DOE/FERC/0028—T1) **Issues involved in adjusting the cost performance ratio of the Alaska Gas Pipeline: selection of an index.** Daly, G.; Rutner, J.L.; Stekler, H. (Institute for Defense Analyses, Arlington, VA (USA). Program Analysis Div.). Apr 1979. Contract EK-78-C-39-0028. 45p. (IDA-P—1416). Dep. NTIS, PC A03/MF A01.

The Federal Energy Regulatory Commission (FERC) is developing proposed rulemaking to resolve outstanding issues concerning the Incentive Rate of Return (IROR) mechanism to be used for segments of the Alaska Natural Gas Transportation system (ANGTS). This paper examines the inflation adjustment mechanism and recommends a key component -- the index -- which is used to adjust the Cost Performance Ratio (CPR). Issues relevant to the selection of indices are discussed, a number of existing indices are examined, and a new composite index is discussed. In addition, the cost categories and price index proxies to be used in the recommended index are presented.

5377 (LIB-tr—4243) **CEDIGAZ report on the development of the Soviet Union's gas potential.** Jan 1977. Translation source information not available. 54p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Importing countries are paying more and more attention to the gas potential of the USSR, because, while in Western countries serious questions are arising about the future of energy supplies, the USSR does not seem unduly worred about a possible energy crisis, being confident that she is sitting on a great underground potential. However, the USSR alone does not seem to be in a position to implement the objectives of its various five-year plans, because of several reasons: there is a lack of infrastructures at the level of the largest gas regions, serious equipment problems, and (usually) a lack of organisation and coordination in carrying out projects. For natural gas, equipment contracts are entered into with Western countries in the form of agreements which can be ranked as a barter (the USSR's gas sales in exchange for deliveries of pipes, drilling and production materials, or else in exchange for a complete liquefaction plant). After the first negotiations between governments and the resulting contract, there will be other negotiations between the real trading partners: on the one hand, the gas seller (the Soviet organisation, Soyuzgasexport) and the Western buyer, and on the other hand the equipment seller (who does not necessarily buy gas) and the Soviet buyer organisation. In fields other than natural gas (chemicals, petrochemicals), equipment contracts are often drawn up on the basis of so-called recompense. To sum up, the various contract formulae enable the USSR to free a large proportion of its investments and to redirect these into other sectors of its economy.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5365, 5366

ENVIRONMENTAL EFFECTS

5378 (PB—289938) **Development and evaluation of an LNG sampling measurement system.** Parrish, W.R.; Arvidson, J.M.; LaBrecque, J.F. (National Bureau of Standards, Boulder, CO (USA). Thermophysical Properties Div.). Jul 1978. 201p. NTIS PC A10/MF A01.

This report describes the development and evaluation of procedures and components for sampling and analyzing LNG from flowing streams. Laboratory and field test results showed the total uncertainty in the computed heating value of samples taken with the recommended sampling system could be routinely within + or - 0.3 percent; this included the + or - 0.1 percent uncertainty in analysis by gas chromatography. Three sample probes and two vaporizer designs were considered. Of the ten operating variables considered, six were found to be important in sampling. Test results were used to establish recommended design and operating criteria.

5379 **Physical solvent absorption of carbon dioxide and hydrogen sulphide for the deacidification of industrial gaseous mixtures.** Blanc, C.; Chenard, J.Y.; Delpuech, J.J.; Oliveau, O. (to Societe Nationale Elf Aquitaine (Production)). US Patent 4,162,903. 31 Jul 1979. Priority date 9 Mar 1977, France, 6p.

The present invention is related to a process for absorbing acid gases from industrial gaseous mixtures by washing under pressure with a solvent. The invention is concerned more particularly with the use of hexamethyl phosphorotriamide $OP[N(CH_3)_2]_3$, pure or mixed with water, as a physical solvent of acid gases. This new physical solvent is of particular interest in the treatment of natural acid gases and refinery gases.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

5380 (DOE/BG/01569—15) **Western Gas Sands Project. Status report, 1 September 1979-30 September 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BG01569. 80p. Dep. NTIS, PC A05/MF A01.

This report summarizes progress of the government-sponsored projects directed toward increasing gas production from the low-permeability gas sands of the western United States. Bartlesville Energy Technology Center continued work on rock-fluid interaction and advanced logging techniques. Lawrence Livermore Laboratory continued experimental and theoretical work on hydraulic fracturing mechanics and analysis of well test data. Los Alamos Scientific Laboratory continued work on permeability and porosity determination of core samples and geological support studies. Sandia Laboratories continued work on their EGR Instrumentation and Diagnostic Program. Cyclic gas injection continued at Colorado Interstate Gas Company's Miller No. 1 and Sprague No. 1 wells. The DOE Well Test Facility is continuing to provide technical support to the Gas Research Institute/Rio Blanco Natural Gas MHF experiment. The Gas Producing Enterprises, Inc. Natural Buttes Unit wells continued to flow to sales. The Mitchell Energy Corporation Muse-Duke No. 1 was opened after a 28-day shut-in period. The hydraulic fracturing containment experiment continued for the Sandia-mineback program.

5381 (ORO—5205-10) **Characterization and analysis of Devonian shales as related to release of gaseous hydrocarbons. Quarterly technical progress report, January-March, 1979.** Kalyoncu, R.S.; Boyer, J.P.; Snyder, M.J. (Battelle Columbus Labs., OH (USA)). 15 Apr 1979. Contract EY-76-C-05-5205. 240p. Dep. NTIS, PC A11/MF A01.

This program has the objective of determining the relationships between the shale characteristics, hydrocarbon gas contents, and well location, and thereby provide a sound basis for (1) assessing the productive capacity of the Eastern Devonian Gas Shale deposits and (2) guiding research, development, and demonstration projects to enhance the recovery of natural gas from the shale deposits. The Y-1 we.l in Allegany County, New York was sampled in September 1978. 412 samples were collected from the Allegany County, New York well. Characterization data on Y-1 (EGSP New York No. 1), Allegany County, New York well is reported and discussed. Analysis of the hydrocarbon gases in Y-1 samples indicates that the longer chain hydrocarbon gases (ethane, propane, butane) in these shales are significantly higher than in previous wells. The carbon contents of the Y-1 (Allegany County, New York) well, on the other hand, are somewhat lower than predicted from the hydrocarbon gas contents. There is still a positive relationship between the carbon and hydrocarbon gas contents, however. A similar relationship is also apparent between the sulfur and hydrocarbon gas contents. No unusual trends are observed in the porosity values, and a reasonable agreement exists between the measured Hg-intrusion values and those calculated from the density data. Higher porosity values are associated with low bulk densities. From limited lithological observations New York shales exhibit variable clay, mineral, and quartz contents. Generally, low levels of pyrite and carbonate minerals are observed. The low pyrite and carbonate contents noted in the powder examination of the samples are supported by the EDAX results showing low Ca and S contents.

5382 (UCRL—50036-79-2) **LLL Gas Stimulation Program. Quarterly progress report, April-June 1979.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J.; Lin, W.; Towse, D.F.; Cleary, M.P.; Haimson, B.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1979. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01.

This report summarizes the research and accomplishments of the LLL Gas Stimulation Program during the third quarter FY 1979. We have continued to analyze dynamic fracture propagation near interfaces. We have also formulated the equations describing pressure evolution in a propagating hydraulic fracture and the numerical simulation of several parameters in these equations has involved intensive study. Experimentally, we have continued our laboratory molding of the aspects of fracturing near interfaces with primary emphasis on the effects of frictional interfaces. Frictional measurements on both sandstone and limestone have shown that the frictional coefficient for sandstone decreases with water saturation, but increases with limestone. Changes in viscosity of the fracturing fluids tend to slow the rate at which the breakdown point is reached. We are also measuring the mechanical and breakage characteristics of reservoir material from the Mesa Verde sections of the Piceance Basin. Cross plotting techniques are being applied to evaluate porosity from logs taken in the Bowdoin area in Montana.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 5329, 5370, 5376, 5824

OIL SHALES AND TAR SANDS

SITE GEOLOGY

REFER ALSO TO CITATION(S) 5381

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 5327

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 5393

5383 (FE—1747-4) **BX In Situ Oil Shale Project. Annual technical progress report, March 1, 1977-February 28, 1978 and quarterly technical progress report, December 1, 1977-February 28, 1978.** Dougan, P.M. (Equity Oil Co., Salt Lake City, UT (USA)). 20 Mar 1978. Contract ET-78-F-03-1747. 31p. Dep. NTIS, PC A03/MF A01.

Objective is to demonstrate the technical feasibility of using superheated steam as a heat-carrying medium to retort in situ the oil shale in the Green River Formation leached zone and provide a mechanism for the recovery of this shale oil with a minimum impact on the environment. About one trillion BTU of heat will be injected into a site over a two-year period to heat to retorting temperature a shale zone approximately 550 feet thick and covering about 1 acre. The field project is located at Equity's BX in situ site in Rio Blanco County in northwestern Colorado. February 28, 1978, ends the first year of work on the BX In Situ Oil Shale Project. Work accomplished during the year included the drilling of two core holes for site evaluation; the evaluation of the Project Site; the initiation of Project design; the establishment of a Laboratory Research Program; and the establishment of an Environmental Research Plan.

5384 (LETC/RI—79/1) **Reverse combustion oil-shale retorting.** Jacobson, I.A. Jr.; Dockter, L. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Jun 1979. 12p. Dep. NTIS, PC A02/MF A01.

Oil shale was retorted in a laboratory retort with the flame front and gas flow moving concurrently and countercurrently. Results indicate countercurrent flow produced a lower oil yield and a higher heating value of the retort gas than concurrent flow. Energy recovery from the oil shale was essentially the same when the retorting was done with either concurrent or countercurrent flame and gas movement. Laboratory results are compared with large scale retorts operated under similar conditions.

5385 **Subterranean in situ oil shale retort and method for making and operating same.** French, G.B.; Ridley, R.D. (to Occidental Oil Shale, Inc.). US Patent 4,118,070. 3 Oct 1978. Filed date 27 Sep 1977. 16p.

An in situ oil shale retort is formed in a subterranean formation containing oil shale. The retort contains a fragmented permeable mass of particles containing oil shale. An open base of operation is excavated in the formation at an elevation above the fragmented mass to be formed, and an access drift is excavated to provide access to the bottom of the retort site. Formation is explosively expanded to form the fragmented mass between the access drift and an elevation spaced below the bottom of the base of operation, leaving a horizontal sill pillar of unfragmented formation between the top of the fragmented mass and the bottom of the base of operation. The sill pillar provides a safe base of operation above the fragmented mass after it is formed. The fragmented mass is formed by, among other steps, drilling blasting holes from the base of operation down through the sill pillar and then detonating explosive in such holes to form the fragmented mass of particles in the retort below the sill pillar. During retorting, gas is introduced into the fragmented mass through such blasting holes for establishing a combustion zone in the fragmented mass and for advancing the combustion zone through the fragmented mass. The blasting holes have separate valves located in the base of operation for use in controlling gas flow through selected regions of the fragmented mass. 23 claims.

5386 (UCRL—83531) **Effect of particle size distribution and flow non-uniformities on dispersion in porous media: application to oil shale retorts.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 30p. (CONF-790398—1). Dep. NTIS, PC A03/MF A01.

From 2. multiphase flow and heat transfer symposium; Miami, FL, USA (16 Mar 1979).

This paper considers the effects of particle size distribution and flow nonuniformities on the dispersion of an inert tracer in porous media using some simplified models, and compares the results to recent dispersion data taken on external retorts filled with oil shale particles. The effect of the particle size distribution is analyzed by studying the dispersion of a tracer in a series of infinite parallel pores of varying diameters. The pores are considered to be in either laminar or turbulent flow. The predicted dispersion coefficient of the porous medium is shown to be a function of the Peclet number and the higher moments of the distribution of pore radii. The Peclet number dependence is in agreement with experimental measurements, as is the qualitative dependence on particle size distribution. The effect of flow nonuniformities is studied by analyzing the dispersion of an inert tracer in a packed bed with two annular regions of different interstitial velocities. The dispersion coefficient for the area-averaged concentration is shown to be a very sensitive function of the parameters in the flow distribution. The dispersion coefficients measured in external retorts or packed beds filled with oil shale particles are much higher than those previously measured using uniform particles of the same average size. These differences can be accounted for if one allows for the possibility of having a significant contribution from flow nonuniformities.

5387 **In situ oil shale retort with a horizontal sill pillar.** Hutchins, N.M. (to Occidental Oil Shale, Inc.). US Patent 4,118,071. 3 Oct 1978. Filed date 25 Apr 1977. 34p.

An in situ oil shale retort is formed in a subterranean formation containing oil shale. The retort with top, bottom, and side boundaries contains a fragmented permeable mass of particles containing oil shale. A base of operation is excavated at a working level in the formation. Means are excavated through the formation for access to a location underlying the base of operation. In one embodiment, a void in the form of a vertical slot is excavated in the site between the means for access and an elevation below the bottom of the base of operation, leaving a remaining portion which is to be expanded toward the void. This is designed to leave a horizontal sill pillar of intact formation between the top of the void and the bottom of the base of operation with a vertical thickness sufficient to maintain a safe base of operation after explosive expansion of formation to form the fragmented permeable mass of particles. The void provides at least one free face extending vertically through the formation within the boundaries of the in situ oil shale retort site. This remaining portion is explosively expanded toward the void with a single round of explosions. 38 claims.

5388 **Method for preconditioning oil shale preliminary to explosive expansion and in situ retorting thereof.** Ridley, R.D. (to Occidental Oil Shale, Inc.). US Patent 4,109,964. 29 Aug 1978. Filed date 3 Jan 1977. 20p.

A technique is provided for forming, in a subterranean deposit containing oil shale, an in situ oil shale retort having boundaries of unfragmented deposit containing a fragmented permeable mass of particles containing oil shale. The technique is particularly useful where at least a portion of the deposition layers of the oil shale deposit within the boundaries of the retort being formed are bonded together as a competent or relativley strong bed resistant to fragmenting. A portion of the deposit within the boundaries of the retort being formed is excavated to form a void with a free face within the boundaries. A second portion of the deposit within the boundaries extending away from the free face includes at least one competent bed. At least one competent bed within the boundaries is fractured substantially parallel to the deposition layer for reducing the effective thickness of the competent bed. The portion of the deposit within the boundaries of the retort being formed is then explosively expanded toward the void with a single round of explosives for fragmenting this portion of the deposit and forming a fragmented permeable mass of particles in an in situ oil shale retort. The fragmented mass is retorted to produce liquid and gaseous products including shale oil. 24 claims.

SURFACE METHODS

REFER ALSO TO CITATION(S) 5363, 5384

5389 **Process for production of hydrocarbonaceous fluids from solids such as coal and oil shale.** Gwyn, J.E.; Roberts, S.C. (to Shell Oil Co.). US Patent 4,110,193. 29 Aug 1978. Filed date 11 Mar 1977. 28p.

A retorting process for recovery of hydrocarbonaceous fluids from subdivided solid materials, specifically oil shale, is described wherein the subdivided solid material is preheated, retorted, and subjected to heat recovery after retorting, heat transfer being effected by contacting the subdivided solid material as a dilute-phase

fluidized bed in a separate preheating zone with a first particulate heat carrier, and with a second particulate heat carrier in a dense fluidized bed in a retorting zone. Separate particulate heat carriers are employed in such manner that one mass of heat carrier is utilized for preheating the solid material and heat recovery, and a second mass of heat carrier is utilized for retorting of the subdivided preheated solid material. 30 claims.

5390 Apparatus and process for extracting oil or bitumen from tar sands. Harding, D.J. (to Magna International Inc.). US Patent 4,110,195. 29 Aug 1978. Priority date 24 Jan 1974, United Kingdom of Great Britain and Northern Ireland (UK), 24p.

An invention is described which relates to an apparatus and process for extracting bitumen from mineral particles such as sand. The invention avoids many of the problems of the conventional hot water or solvent extraction processes by using an abrading process to remove the bitumen or oil from sand particles, using cool water and little solvent. The abrading process involves agitating a pulp of tar sand and water, preferably with some small amount of diluent, and then moving this around an annular space at a speed low enough to allow settling of clean sand to form a sand bed in contact with the moving pulp, the speed being high enough to prevent settling of bitumen coated sand particles, so that the bitumen is abraded from the sand particles; and rises in the pulp. Fines and clay which are removed with the water and bitumen can be separated from the water, after removal of the bitumen, to give a sludge suitable for mixing with the clean sand prior to disposal. 42 claims.

5391 Process and apparatus for extracting bituminous oil from tar sands. Peterson, G.R.; Hicks, M.C.; Schwartz, P.W. (to Intermountain Oil Research, Inc.). US Patent 4,110,194. 29 Aug 1978. Filed date 16 Apr 1976. 10p.

Tar sands are put into finely divided form, preferably by pressing them into sheets and flaking the sheets. The flakes are mixed with a solvent for the contained oils for a time sufficient to extract the oils. The resulting slurry is introduced beneath the surface of a body of water and the solids allowed to settle, while the solvent containing the oil rises to the top to form a liquid phase above the surface of the body of water. The wet solids and the oil-containing solvent are separately removed. After the oil is recovered from the solvent, as by fractional distillation, the solvent is recycled in the process, which is preferably carried on as a continuous operation. 15 claims.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5345

WASTE RESEARCH AND MANAGEMENT

REFER ALSO TO CITATION(S) 5394

5392 (PNL-SA—7795) **Contribution of thiosulfate to COD and BOD in oil shale process wastewater.** Wong, A.L.; Mercer, B.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 19p. (CONF-790663—2). Dep. NTIS, PC A02/MF A01.

From Symposium on analysis of waters associated with alternate fuel production; Pittsburgh, PA, USA (4 Jun 1979).

Thiosulfate accounted for a significant portion of the chemical oxygen demand (COD) (7 to 20%) and biochemical oxygen demand (BOD) (14 to 41%) of the four oil shale process waters studied. As such, accurate measurement of the thiosulfate oxygen demand of retort water is critical in assessing its environmental impacts on receiving waters and in designing biological treatment systems to treat it. The contribution of thiosulfate to the COD of oil shale retort waters can be accurately measured in a standard COD test. The BOD of thiosulfate in retort water is more difficult to determine and may require the development of a special thiosulfate acclimated seed. Thiosulfate recovery of a known thiosulfate spike ranged from 92 to 100% in the COD test and from 64 to 119% in the BOD test. Considerable variability in recovery was found between the process waters studied. When determining the BOD of oil shale process waters, care must be taken to insure a viable population of thiosulfate oxidizing bacteria.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5392, 6181, 6183

5393 (LETC/TPR—79-1) **Analysis of stack gas pollutants produced by in situ combustion of oil shale: a preliminary report from Rock Springs Site 12.** Owen, T.E.; McDonald, F.R. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Oct 1979. 41p. Dep. NTIS, PC A03/MF A01.

Monitoring of the in situ oil shale project at Rock Springs, Wyoming, Site 12 was attempted on a sideburn experiment prior to ignition of the main experiment. Although this monitoring would not be entirely representative of a mainburn experiment, it was felt that the results could act as guidelines for our mainburn monitoring effort. This presents the results of the sideburn monitoring effort and discusses some of the problems which were encountered.

5394 (PNL-SA—7051) **Microbiological aspects of the ground disposal of oil shale wastes.** Rogers, J.E.; Li, S.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 7p. (CONF-7806171—1). Dep. NTIS, PC A02/MF A01.

From Northwest regional meeting of the American Society of Microbiology; Vancouver, Canada (30 Jun 1978).

The microbiological aspects of the ground disposal of solid retorted shale wastes and retort water wastes are discussed. These wastes are produced from an above ground retorting operation operating in the direct heat mode. It was found that both bacteria and fungi can colonize retorted shale and that the types of bacteria present change with time. With regard to retort water wastes, the results suggest that bacteria can grow on retort water, however the presence of phosphates is essential. Bacteria and fungi can utilize organic residues of retort water.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 5891

EXPLORATION

REFER ALSO TO CITATION(S) 5349

5395 (GJBX—125(79)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Montrose NTMS quadrangle, Colorado, including concentrations of forty-three additional elements. Informal report.** Broxton, D.E.; Morris, W.A.; Bolivar, S.L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract EY-76-C-13-1664. 255p. (LA—7507-MS). Dep. NTIS, PC A12/MF A01.

1365 water samples were collected from streams, springs, and wells and were analyzed for uranium and 12 other elements. 1857 sediment samples, taken from streams and springs, were analyzed for uranium, thorium, and 41 other elements. Uranium concentrations of water samples range from below the detection limit of 0.02 ppB to 209.50 ppB. Twelve areas are delineated by water samples with anomalous uranium concentrations; nine of these are associated with known uranium occurrences. In the crystalline terrane on the eastern side of the quadrangle, water samples with anomalous uranium concentrations are predominantly associated with Precambrian X granitic and metamorphic rocks, Precambrian Y alkalic plutons, Paleozoic-Mesozoic sedimentary formations, and Tertiary volcanic and sedimentary rocks. Water samples with anomalous uranium concentrations also occur in areas underlain by mid-Tertiary volcanic rocks of the San Juan volcanic field in the southeast part of the quadrangle and by the Mancos and Mesaverde formations in the western part of the quadrangle. Uranium concentrations of sediment samples range from 0.94 to 136.80 ppM. Seven areas are delineated by sediment samples with anomalous uranium concentrations; six of these are associated with known uranium occurrences. The anomalous clusters are associated with areas underlain by felsic plutonic rocks of the mid-Tertiary Mt. Princeton batholith, Precambrian X granitic and metamorphic rocks in fault or unconformable contact with Paleozoic formations, undivided Precambrian X and Y granites faulted against Paleozoic and Mesozoic sedimentary rocks, and felsic plutonic rocks of the Laramide Twin Lakes stock. Most of the sediment samples with anomalous uranium concentrations also have elevated thorium concentrations and high uranium/thorium ratios.

5396 (GJBX—153(79)(Vol.2)) **NURE aerial gamma-ray and magnetic reconnaissance survey: Colorado-Arizona area, Craig NK 13-10 quadrangle.** (LKB Resources, Inc., Huntingdon Valley, PA (USA)). Sep 1979. Contract EY-76-C-13-1664. 210p. Dep. NTIS, PC A10/MF A01.

Volume II contains magnetic and ancillary stacked profile data, radiometric multiple-parameter stacked profiles, histograms, anomaly maps, flight path map, and geologic base map for the Craig NK 13-10 quadrangle in the Colorado-Arizona area.

5397 (GJBX—160(79)) **Savannah River Laboratory semiannual report, April-September 1979. Hydrogeochemical and stream sediment reconnaissance: National Uranium Resource Evaluation Program.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River

Lab.). Oct 1979. Contract EY-76-C-09-0001. 37p. (DPST—79-138-2). Dep. NTIS, PC A03/MF A01.

This report summarizes the accomplishments, status, and program of the Savannah River Laboratory (SRL) contribution to the National Uranium Resource Evaluation (NURE) program. SRL has accepted responsibility for Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) of 1,500,000 square miles in 30 eastern and 7 far-western states. The report is a progress report covering the period April 1979 through September 1979. SRL efforts in the following areas are discussed: reconnaissance and detailed studies in geological programs; management, analysis, and interpretation of analytical and field data; reporting of HSSR results; sample preparation methods; and neutron activation analysis and other analytical techniques. Appendix A to the report summarizes the SRL-NURE production of the April 1979-September 1979 period and the program plans for the first half of FY-1980. Page-scale maps are included that show the status of completed sampling, analysis, and data reports placed on open file.

5398 (GJBX—162(79)) **Diamond drilling for geologic information in the middle Precambrian basins in the western portion of northern Michigan. Final report.** Trow, J. (Michigan Dept. of Natural Resources, Lansing (USA). Geological Survey Div.). Oct 1979. Contract EY-76-C-13-1664. 127p. Dep. NTIS, PC A07/MF A01.

Between September 26, 1977, and May 11, 1978, six initially vertical holes probed a total of 9896 feet (1109 feet or 11.2% in overburden, 155 feet or 1.6% in Precambrian Y mafic dikes, 8386 feet or 84.7% in Precambrian X Goodrich Quartzite and Michigamme Formation, and 246 feet or 2.5% in Precambrian W basement lithologies). In addition to normal examination of core, logging, and storing of core, the holes were extensively logged geophysically, acidized core was tested for phosphate content by ammonium molybdate, splits from five out of every thirty feet of core were subjected to chemical scrutiny, thin sections of all lithologies were examined, and radiometric determinations of geologic age were made for confirmation of Precambrian W basement which was encountered in each of the three basins in Marquette County.

5399 (GJBX—165(79)) **Neutron transport measurements and source monitor development for uranium borehole logging sonde. Final report.** Verbinski, V.; Stamatelatos, M.; Cassapakis, C.; Patricelli, F. (Science Applications, Inc., La Jolla, CA (USA)). 11 Dec 1978. Contract EY-76-C-13-1664. 85p. Dep. NTIS, PC A05/MF A01.

The first part discusses the design and results of a ^{252}Cf-neutron and a 14-MeV neutron benchmark experiment for verifying previously developed theoretical methods for use in the design of a neutron logging tool for uranium borehole exploration. The second part discusses the Science Applications, Inc. (SAI) development of a fast fission monitor for measuring 14-MeV neutrons for a D-T borehole sonde in a high neutron moderating and absorbing environment. The 14-MeV pulsed neutron monitor was used in carrying out the 14-MeV neutron benchmark experiment, and a variation on the method of quantitatively counting many events in one burst of pileup counts, developed for the 14-MeV-pulsed neutron monitor, was employed in successfully counting the epithermal neutrons produced by a short (2 μs) burst of 14-MeV neutrons. Thus, the development of the 14-MeV-neutron monitor and the measurements with 14-MeV neutrons were intimately related.

5400 (GJBX—167(79)) **Aerial radiometric and magnetic survey: Vernal National Topographic Map, Colorado and Utah.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 217p. Dep. NTIS, PC E14/MF E14.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Vernal National Topographic Map NK12-12 is presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium, and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

5401 (GJBX—168(79)) **Aerial radiometric and magnetic survey: McDermitt National Topographic Map, Nevada, Oregon, and Idaho.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 308p. Dep. NTIS, PC E17/MF E17.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the McDermitt National Topographic Map NK11-8 is presented. The airborne data gathered is reduced by ground computer facilities to yield profile plots of the basic uranium, thorium, and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

5402 (GJBX—169(79)(Vol.1)) **Analysis of airborne radiometric data. Volume 1. Evaluation of the DELPHI/MAZAS computer code. Final report.** Sperling, M.; Shreve, D.C.; Reed, J.H. (Science Applications, Inc., La Jolla, CA (USA)). 1 Dec 1978. Contract EY-76-C-13-1664. 127p. (SAI—78-997-LJ(Vol.1)). Dep. NTIS, PC A07/MF A01.

Testing and evaluation of the code MAZAS/DELPHI led to the following conclusions: its precision is better than the Window method for the analysis of uranium, comparable for the analysis of potassium, and worse for the analysis of thorium. Its accuracy of MAZAS is consistently better than the Window method when used on simulated data. The accuracy of the average values of the individual gamma-ray intensities obtained with MAZAS is good over the entire energy spectrum for the uranium and thorium spectra. The precision of the intensities of the low energy lines is poor unless 15 to 20 s integration times are used. Results of the analysis of actual flight data for potassium and thorium are very similar for MAZAS and the Window method. Results for uranium using MAZAS and the Window method appear to be different. MAZAS, which measures an average of several discrete gamma-ray components, seems to indicate considerably more airborne radon than the Window method. It is suspected that the Window method is measuring a combination of discrete and continuum components and that this is resulting in analyses that are inconsistent with MAZAS. The DELPHI time filter appears to work exceedingly well on simulated data. The accuracy of the method on actual flight data is uncertain.

5403 (GJBX—169-79(Vol.2)) **Analysis of airborne radiometric data. Volume 2. Description, listing, and operating instructions for the code DELPHI/MAZAS. Final report.** Sperling, M.; Shreve, D.C. (Science Applications, Inc., La Jolla, CA (USA)). 1 Dec 1978. Contract EY-76-C-13-1664. 199p. (SAI—78-997-LJ(Vol.2)). Dep. NTIS, PC A09/MF A01.

The computer code DELPHI is an interactive English language command system for the analysis of airborne radiometric data. The code includes modules for data reduction, data simulation, time filtering, data adjustment and graphical presentation of the results. DELPHI is implemented in FORTRAN on a DEC-10 computer. This volume gives a brief set of operations instructions, samples of the output obtained from hard copies of the display on a Tektronix terminal and finally a listing of the code.

5404 (GJBX—169(79)(Vol.3)) **Analysis of airborne radiometric data. Volume 3. Topical reports.** Reed, J.H.; Shreve, D.C.; Sperling, M.; Woolson, W.A. (Science Applications, Inc., La Jolla, CA (USA)). May 1978. Contract EY-76-C-13-1664. 111p. (SAI—78-997-LJ(Vol.3)). Dep. NTIS, PC A06/MF A01.

This volume consists of four topical reports: a general discussion of the philosophy of unfolding spectra with continuum and discrete components, a mathematical treatment of the effects of various physical parameters on the uncollided gamma-ray spectrum at aircraft elevations, a discussion of the application of the unfolding code MAZNAI to airborne data, and a discussion of the effects of the nonlinear relationship between energy deposited and pulse height in NaI(T1) detectors.

5405 (GJBX—169(79)(Vol.4)) **Analysis of airborne radiometric data. Volume 4. MAZNAI code for gamma-ray spectral enhancement.** Reed, J.H.; Shreve, D.C.; Sperling, S.M. (Science Applications, Inc., La Jolla, CA (USA)). 17 Jan 1979. Contract EY-76-C-13-1664. 66p. (SAI—78-997-LJ(Vol.4)). Dep. NTIS, PC A04/MF A01.

In gamma-ray spectrometry measurements, an energy distribution of gamma-rays is viewed by a spectrometer which in turn produces a data set. This data is the result of a complex detection process and generally suffers from loss of resolution due to this detection process and to statistical noise. It is the purpose of the MAZNAI computer program to remove the degrading effects of the detector, to minimize the effects of statistical fluctuations, and to construct an enhanced image spectrum that corresponds as closely as possible to the spectrum of radiation incident on the detector. Section 2 of this report gives a brief description of the MAZNAI methodology, Section 3 discusses detector response functions. Section 4 is the user's guide which describes particular details of the preparation of the data necessary for running the code. Appendix A contains the code listing. The Berger and Seltzer Publication, which

is the basis for the adopted detector response function parameterization, is included as Appendix B.

5406 (GJBX—172(79)) **Aerial radiometric and magnetic survey: Richfield National Topographic Map, Utah.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 368p. Dep. NTIS, PC E15/MF E15.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Richfield National Topographic Map NJ12-4 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

5407 (GJBX—174(79)) **Aerial radiometric and magnetic survey; McAlester National Topographic Map, Oklahoma, Arkansas.** (Geodata International, Inc., Dallas, TX (USA)). 1979. Contract EY-76-C-13-1664. 235p. Dep. NTIS, PC E09/MF E09.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the McAlester National Topographic Map NI15-4 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

5408 (LA-UR—79-3249) **NURE and the National Park Service.** Weaver, T.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-791138—1). Dep. NTIS, PC A02/MF A01.

From 2. conference on scientific research in the national parks; San Francisco, CA, USA (26 Nov 1979).

Under the National Resource Evaluation (NURE), massive amounts of geological, geochemical, and geophysical data, covering the entire conterminous 48 states and Alaska, are being collected and made public. In addition to NURE goals, these data are applicable to various other researches on and in the vicinity of lands controlled by the National Park Service. Airborne geophysical and hydrogeochemical survey NURE data have been made public for the majority of the area in the combined Mt. McKinley National Park and Denali National Monument. Besides indicating potential raw material deposits, these data are also useful for geologic mapping, water quality, pollution and othe geological, biological, and environmental studies in the park.

MINING

5409 (NUREG/CR—0628(Rev.)) **Prediction of the net radon emission from a model open pit uranium mine.** Nielson, K.K.; Perkins, R.W.; Schwendiman, L.C.; Enderlin, W.I. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 23p. (PNL—2889(Rev.)). Dep. NTIS, PC A02/MF A01.

Radon emission from a model open pit uranium mining operation has been estimated by applying radon exhalation fluxes measured in an open pit uranium mine to the various areas of the model mine. The model mine was defined by averaging uranium concentrations, mine dimensions, production and procedural statistics for eight major open pit uranium mines in the Casper, Wyoming area. The resulting emission rates were 630 Ci/RRY (1 RRY one = 1000-MW(e) reactor operating for 1 year) during mining operations and 26 Ci/RRY/y after abandoment of the mine assuming 100% recovery of U_3O_8 from the ore, or 700 Ci/RRY and 29 Ci/RRY/y assuming 90.5% recovery.

FEED PROCESSING

5410 **In situ carbonate leaching and recovery of uranium from ore deposits.** Hunkin, G.G.; Fife, T.P.; Stano, J.R. (to Wyoming Mineral Corp.). US Patent 4,155,982. 22 May 1979. Filed date 9 Oct 1974. 18p.

Uranium is leached from redox roll ore deposits by selective in-situ leaching with a solution of pH 7.4 to 9 (preferably 7.5 to 8.5) containing from about 0.5 to 5g/l of NH_4HCO_3 and from about 0.1 to 3g/l of peroxide (preferably aqueous H_2O_2), and sufficient NH_3 to maintain the desired pH. The leach solution is then withdrawn from the ore deposit and contacted with a strong base anion exchange material to strip the uranium from the leach solution. The uranium is eluted from the anion exchange material by an aqueous eluant, and the uranium is recovered from the eluate by first acidifying it and then treating it with ammonia to produce a precipitate of relatively pure ammonium diuranate. The content of the three components in the stripped leach solution is adjusted, and then the leach solution is recirculated through the ore deposit. After the uranium ore is removed to the extent economically practicable, the leach solution is replaced with an aqueous reducing solution which when passed into the ore deposit precipitates and renders insoluble any uranium and elements such as vanadium, molybdenum, and selenium. This process produces above ground a very low volume of impurities and waste solutions requiring disposal and does not cause material contamination of the underground deposit or any aquifer associated with the deposit.

ENRICHMENT

LASER EXCITATION

5411 (UCRL-Trans—11511) **Method for separating uranium isotopes.** Ueyanagi, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Translation of Japanese Patent 4,995-1977, 14 Jan 1977. 20p. Dep. NTIS, PC A02/MF A01.

A method is for separating uranium isotopes in which isotopes of ^{235}U are separated by multistage photoionization. This method is characterized by the fact tht selective ionization of ^{235}U is performed by using an energy level of 28,504 cm^{-1} from the ground state as the first-stage excited level, by using laser-oscillated light based on the transition $5p^3P_2 \rightarrow 5s^3S_1{}^0$ from among the transitions of the bivalent ion Kr III of krypton as the laser light for excitation to that level, and by applying a magnetic field to the uranium vapor and/or to the above-mentioned laser in order to equalize the energy difference with the ground state of the above-mentioned ^{235}U level and the energy of the photons discharged by the above-mentioned laser.

5412 (UCRL-Trans—11512) **Method for separating uranium isotopes.** Ueyanagi, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Translation of Japanese Patent 39,098-1977, 26 Mar 1977. 11p. Dep. NTIS, PC A02/MF A01.

A method is claimed for separating uranium isotopes by means of laser selective deflection of ^{235}U. This method if characterized by the fact that an energy level of 28,504 cm^{-1} from the ground state is used as the excited level used in resonance scattering. Laser-oscillated light based on the transition $5p^3P_2$-$5s^3S_1{}^0$ from among the transitions of the bivalent ion Kr III of krypton is used as the laser light for excitation to that level. Selective deflection of ^{235}U is performed by applying a magnetic field to the uranium vapor or the above-mentioned lasers or both, and equalizing the energy difference from the ground state of the above-mentioned ^{235}U level with the energy of the photons discharged by the above-mentioned lasers.

5413 (UCRL-Trans—11513) **Method for separating uranium isotopes.** Yamamoto, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Translation of Japanese Patent 24,699-1977. 13p. Dep. NTIS, PC A02/MF A01.

A method is claimed for separating uranium isotopes by means of selective photoexcitation, characterized by the fact that energy levels of either 24,609 cm^{-1}, 28,669 cm^{-1}, 27,060 cm^{-1}, 20,851 cm^{-1}, 21,831 cm^{-1}, 21,584 cm^{-1}, 20,306 cm^{-1} or 22,633 cm^{-1} in terms of wave numbers from the ground state are used as the excited levels of the uranium atoms. Laser beams of lead atoms with a wavelength of 4062.13 A, laser beams of bivalent krypton ions with a wavelength of 3564.23 A, laser beams of bivalent xenon ions with a wavelength of 3780.97 A, laser beams of bivalent xenon ions with a wavelength of 4794.48 A, laser beams of univalent argon ions with a wavelength of 4579.35 A, laser beams of univalent chlorine ions with a wavelength of 4768.68 A, laser beams of univalent chlorine ions with a wavelength of 5078.28 A, or laser beams of univalent oxygen ions with a wavelength of 4416.97 A are used, for each of the levels listed above, as the light for exciting to the given levels. Selective photoexcitation of the uranium isotopes is performed by applying a magnetic field on the uranium atoms, the above-mentioned laser light generat-

ing substance, or both, and equalizing the transition wave number of the uranium atoms with the wave number of the above-mentioned laser light.

5414 (UCRL-Trans—11515) **Method for separating uranium isotopes.** Ueyanagi, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Translation of Japanese Patent 22,698-1977, 21 Feb 1977. 15p. Dep. NTIS, PC A02/MF A01.

A method is claimed for separating uranium isotopes by means of selective photoionization or selective photodeflection of ^{235}U. It is characterized by the fact that the wavelength of the second or third higher harmonics of a laser using neodymium as its active substance is adjusted to match the wavelength of the absorption line from an energy level of 620 cm^{-1} from the ground state of ^{235}U.

5415 (UCRL-Trans—11516) **Apparatus for uranium enrichment by double photoionization.** Laude, J.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Translation of French Patent Application 7,419,708, filed date 7 Jun 1974. 9p. Dep. NTIS, PC A02/MF A01.

The present invention concerns uranium enrichment by double photoionization. It is known that the beam of a dye laser can be used to excite gaseous uranium, and the present invention concerns an apparatus of this type. The objective of the invention is essentially to provide an apparatus having a high energy efficiency. This is achieved according to the invention by the fact that a continuous-wave laser is used. In a first form, the invention therefore provides an apparatus for uranium enrichment by double photoionization, containing a dye laser whose beam is directed at the uranium vapors to excite one uranium isotope, characterized by the fact that the laser is a continuous-wave laser. According to another particularity of the present invention, rhodamine 6 G or B is used as dye. The wavelength of the laser beam is controlled optically so that it corresponds to an energy level of one of the uranium isotopes. This wavelength is chosen from the group consisting of the following wavelengths, expressed in A: 5500.69, 5511.49, 5557.87, 5564.17, 5610.89, 5620.78, 5621.51, 5634.32, 5634.38, 5780.59, 5781.95, 5782.81, 5915.40, 5971.59, 5976.32, 5986.10, and 6077.29.

5416 (UCRL-Trans—11514) **Separation equipment for uranium isotopes.** Yamamoto, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 May 1977. Translation of 63,598-1977. 11p. Dep. NTIS, PC A02/MF A01.

Separation equipment for uranium isotopes consists of a first laser using a rare gas or a rare gas compound as its active substance; a second, tunable laser which is subjected to photoexcitation by the first laser; a device for generating uranium vapor; and a means for irradiating the above-mentioned uranium vapor with the light of the above-mentioned first (rare gas) laser and the light of the above-mentioned second (tunable) laser inside the above-mentioned first (rare gas) laser's photoresonator.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 5985

5417 (HEDL-SA—1723) **Automated inspection of nuclear fuel pellets.** McLemore, D.R.; Wilks, R.S.; Nyman, D.H.; Brady, R.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 13p. (CONF-790602—89). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

The evolutionary development of the automated fuel pellet inspection system has involved several man years of effort and the testing of five different engineering prototypes. Experience gained from the process testing of this latest generation of the automated fuel pellet gaging system will be used to design and build a production unit which is completely automated and can be maintained remotely.

5418 (HEDL-SA—1727-FP) **Remote fabrication of pellet fuels for United States breeder reactors.** Dahl, R.E.; Nyman, D.H.; Yatabe, J.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1979. Contract EY-76-C-14-2170. 12p. (CONF-790602—90). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Goal of the program is to demonstrate the feasibility of fabricating breeder fuel in a remotely operated and maintained mode by 1985. Development for pellet fuel fabrication is in the engineering stage with much of the equipment for ceramic unit operations in final design or currently under testing. Results to date confirm that remote fabrication of pellet fuels is feasible. Several of the processes and equipment items are described in this report.

5419 (HEDL-SA—1895-FP) **Fabrication of 0.5-inch diameter FBR mixed oxide fuel pellets.** Rasmussen, D.E.; Benecke, M.W.; McCord, R.B. (Hanford Engineering Development Lab., Richland, WA (USA)). 12 Sep 1979. Contract EY-76-C-14-2170. 43p. (CONF-791045—4). Dep. NTIS, PC A03/MF A01.

From American Ceramic Society conference; New Orleans, LA, USA (14 Oct 1979).

Large diameter (0.535 inch) mixed oxide fuel pellets for Fast Breeder Reactor application were successfully fabricated by the cold-press-and-sinter technique. Enriched UO_2, PuO_2-UO_2, and PuO_2-ThO_2 compositions were fabricated into nominally 90% theoretical density pellets for the UO_2 and PuO_2-UO_2 compositions, and 88% and 93% T.D. for the PuO_2-ThO_2 compositions. Some processing adjustments were required to achieve satisfactory pellet quality and density. Furnace heating rate was reduced from 200 to 50°C/h for the organic binder burnout cycle for the large, 0.535-inch diameter pellets to eliminate pellet cracking during sintering. Additional preslugging steps and die wall lubrication during pressing were used to eliminate pressing cracks in the PuO_2-ThO_2 pellets.

5420 (ORNL/TM—6924) **Gel-sphere-pac reactor fuel fabrication and its application to a variety of fuels.** Olsen, A.R.; Judkins, R.R. (comps.). (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 303p. Dep. NTIS, PC A14/MF A01.

The gel-sphere-pac fuel fabrication option was evaluated for its possible application to commercial scale fuel fabrication for 19 fuel element designs that use oxide fuel in metal clad rods. The dry gel spheres are prepared at the reprocessing plant and are then calcined, sintered, inspected, and loaded into fuel rods and packed by low-energy vibration. A fuel smear density of 83 to 88% theoretical can be obtained. All fuel fabrication process steps were defined and evaluated from fuel receiving to finished fuel element shipping. The evaluation also covers the feasibility of the process, the current status of technology, estimates of the required time and cost to develop the technology to commercial status, and the safety and licensability of commercial scale plants. The primary evaluation was for a Light-Water Reactor fuel element containing $(U,Pu)O_2$ fuel. The other 18 fuel element types - 3 for Light-Water Reactors, 1 for a Heavy-Water Reactor, 1 for a Gas-Cooled Fast Reactor, 7 for Liquid-Metal-Cooled Fast Breeder Reactors, and 3 pairs for Light-Water Prebreeder and Breeder Reactors - were compared with the Light-Water Reactor. The gel-sphere-pac option was found applicable to 17 of the 19 element types; the characteristics of a commercial scale plant were defined for these for making cost estimates for such plants. The evaluation clearly shows the gel-sphere-pac process to be a viable fuel fabrication option. Estimates indicate a significant potential fabrication cost advantage for the gel-sphere-pac process if a remotely operated and remotely maintained fuel fabrication plant is required.

SPENT FUELS REPROCESSING

5421 (AGNS—35900-CONF-38) **Remote handling systems at the Barnwell Nuclear Fuel Plant: an overview.** Atchinson, G.; Cottrell, J.E.; Sears, L.F. (Allied-General Nuclear Services, Barnwell, SC (USA)). Oct 1979. Contract ET-78-C-09-1040. 42p. Dep. NTIS, PC A03/MF A01.

Facility design of the Barnwell Nuclear Fuel Plant incorporates a combination of remote and contact-maintenance systems. Several unique concepts were employed in the remote-systems design to assure minimal radiation exposure to personnel and operational efficiency. Extensive checkout has been conducted to assess the performance of underwater handling, sampling, hot cell, and specially shielded transfer equipment. Innovative solutions to remoting deficiencies have been applied to enhance plant operating capability.

5422 (CONF-791203—5) **Producing better HPs at the Idaho Chemical Processing Plant.** Willis, C.L.; Rich, B.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

From Health Physics Society meeting; Honolulu, HI, USA (10 Dec 1979).

Health Physics technicians at the ICPP are trained in a four-part program as follows: (1) They participate in the general health and safety indoctrination program along with other plant employees. (2) They attain Qualification status under the health physics Job Proficiency training program which enables them to do the job in a competent manner. (3) They may attain Certification status which gives them the ability to exercise judgement more reliably and to function independently and effectively in new or unusual situations. (4) They have a continuous training program which provides an opportunity for both a review of old, dependable methods and also a look at State-of-the-Art applications of health physics.

5423 (CONF-791218—1) **Interactive computerized laboratory data management system.** Mirrop, C.A.; Baldwin, J.M.; Camarata, A.R.; Halverson, G.D.; Hand, R.L.; Wade, M.A.; Zack, N.R.

(Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 4 Dec 1979. Contract EY-76-C-07-1570. 26p. Dep. NTIS, PC A03/MF A01.

From 6. annual conference of the data general users group; New Orleans, LA, USA (4 Dec 1979).

In support of this effort, an average of 55 samples with approximately 4 analyses per sample comes into the ICPP analytical laboratory each day. Information concerning these samples, the 60 people handling the samples, and the 90 methods of running samples is registered, processed, and accessed daily. A manual paper system was found to be inadequate for an efficient, accurate, interacting network; thus, the need for a more spontaneous system emanated. The Analytical Laboratory Computer System is designed to automate and streamline the generation and storage of this data and to increase the credibility of sample results. A 256 K byte Data General Eclipse C/300, a 62 K byte Hewlett-Packard 9845A, and 8 Tetronix 4023 terminals are being used to achieve this goal. The Eclipse is used for data input-output and the calculation and bias correction of laboratory results; the 9845 computer is used for data manipulation for quality control. Utilization of the data provides some powerful tools in such areas as quality control, data classification, and analyst/method performance evaluation. The simplicity and clarity of operating the system as well as the complexities of design and implementation are also discussed.

5424 (DPSPU—79-30-12A) **SRP Purex Plant: 25 years of successful remote operation.** McKibben, J.M.; Starks, J.B.; Brown, J.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Sep 1979. Contract EY-76-C-09-0001. 15p. (CONF-791103—56). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

At the Savannah River Plant, the PUREX plant has successfully processed irradiated natural and depleted urnaium targets for 25 years to recover plutonium, uranium, and neptunium. All operations are remote. The plant has operated efficiently to produce desired products. Performance has been outstanding in the areas of safety, radiation, and contamination control, and health protection. Successful operation of such a remote facility requires a good equipment mockup facility, reliable and easily removable connectors, ample spare equipment, remote decontamination facilities, and careful design of equipment for rapid remote replacement. The design philosophy of this facility is an adequate general model for future generations of fuel separations plants.

5425 (GA-A—14860) **Design evaluaion: pneumatic transport and classification.** McNair, J.M. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76SF71053. 43p. Dep. NTIS, PC A03/MF A01.

This report describes the evaluation of selected design features of the cold engineering scale pneumatic transport and classification subsystems used in the development of the head-end equipment for HTGR fuel reprocessing. The report identifies areas that require further design effort and evaluation of alternatives prior to the design of the HTGR reference recycle facility (HRRF). Seven areas in the transport subsystem and three in the classification subsystem were selected for evaluation. Seventeen specific recommendations are presented for further design effort.

5426 (HEDL-SA—1935) **Dissolution of mixed oxide fuel as a function of fabrication variables.** Lerch, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 54p. (CONF-791086—3). Dep. NTIS, PC A04/MF A01.

From US/United Kingdom information exchange on dissolution of nuclear fuel; Windscale, UK (16 Oct 1979).

Dissolution properties of mechanically blended mixed oxide fuel were very dependent on the six fuel fabrication variables studied. Fuel sintering temperature, source of PuO_2 and PuO_2 content of the fuel had major effects: (1) as the sintering temperature was increased from 1400 to 1700°C, pellet dissolution was more complete; (2) pellets made from burned metal derived PuO_2 were more completely dissolved than pellets made from calcined nitrate derived PuO_2 which in turn were more completely dissolved than pellets made from calcined nitrate derived PuO_2; (3) as the PuO_2 content decreased from 25 to 15 wt % PuO_2, pellet dissolution was more complete. Preferential dissolution of uranium occurred in all the mechanically blended mixed oxide. Unirradiated mixed oxide fuel pellets made by the Sol Gel process were generally quite soluble in nitric acid. Unirradiated mixed oxide fuel pellets made by the coprecipitation process dissolved completely and rapidly in nitric acid. Fuel made by the coprecipitation process was more completely dissolved than fuel made by the Sol Gel process which, in turn, was more completely dissolved than fuel made by mechanically blending UO_2 and PuO_2 as shown below. Addition of uncomplexed fluoride to nitric acid during fuel dissolution generally rendered all fuel samples completely dissolvable. In boiling 12M nitric acid, 95 to 99% of the plutonium which was going to dissolve did so in the first hour. Irradiated mechanically blended mixed oxide fuel with known fuel fabrication conditions was also subjected to fuel dissolution tests. While irradiation was shown to increase completeness of plutonium dissolution, poor dissolubility due to adverse fabrication conditions (e.g., low sintering temperature) remained after irradiation.

5427 (PNL—2080-18) **Investigation of air cleaning processes for removing tributyl phosphate vapors from commercial fuel reprocessing off-gas streams. Project termination report.** Parker, G.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 61p. Dep. NTIS, PC A04/MF A01.

Solid sorbents were examined for removing TBP vapors from commercial nuclear fuel dissolver and vessel vent off-gas streams. The study identified one commercially available alumina catalyst which proved to be an effective, superior sorbent for TBP. Analytical and procedural methods were developed for handling and measuring low concentrations of TBP. Results of the experiments to demonstrate the protection of silver-impregnated mineral beds raised an important question, yet unanswered, regarding the necessity of removing TBP from process streams for some silver-impregnated beds to attain full stoichiometric removal of iodine.

5428 (PNL-SA—7548) **Instrument for determining the transuranic element content of chopped leached fuel hulls and other materials.** Brodzinski, R.L.; Wogman, N.A.; Nielson, H.L.;Brown, D.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 13p. (CONF-790707—35). Dep. NTIS, PC A02/MF A01.

From 20. annual meeting of the Institute of Nuclear Materials Management; Albuquerque, NM, USA (16 Jul 1979).

An instrument has been designed, constructed, and evaluated for the identification and quantitative determination of transuranic elements by detection of neutrons emitted from their (α, n) and spontaneous fission reactions. Although optimized for batch evaluation of chopped leached nuclear fuel cladding hulls, the principle can be adapted to continuous feed operations. Unique electronic circuitry permits the sorting of neutron emissions depending on their origin which can be directly related to the isotopic composition of very small amounts of transuranic activities present in extreme gamma radiation fields. Efficiencies, sensitivities, and detection limits are discussed.

5429 (UCRL—83628) **Nondestructive, energy-dispersive, x-ray fluorescence analysis of product stream concentrations from reprocessed nuclear fuels.** Camp, D.C.; Ruhter, W.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1979. Contract W-7405-ENG-48. 17p. (CONF-791117—15). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

Energy-dispersive x-ray fluorescence analysis (XRFA) can be used to measure nondestructively pure and mixed U/Pu concentrations in process streams and hold tank solutions. The 122-keV gamma ray from ^{57}Co excites the actinide K x rays which are detected by a HPGe detector. A computer- and disk-based analyzer system provides capability for making on-stream analyses, and the noninvasive measurement is easily adapted directly to appropriate sized pipes used in a chemical reprocessing plant. Measurement times depend on concentration and purpose but vary from 100 to 500s for process control of strong to weak solutions. Accountability measurements require better accuracy thus more time; and for solutions containing plutonium, require a measurement of the solution radioactivity made with an automatic shutter that eclipses the two exciting sources. Plutonium isotopic abundances can also be obtained. Concentrations in single or dual element solutions from less than 1 g/l to over 200 g/l are determined to an accuracy of 0.2% after calibration of the system. For mixed solutions the unknown ratio of U to Pu is linearly related to the net U/Pu K x-ray intensities. Concentration values for ratios different than the calibration ratio require only small corrections to the values derived from a calibration polynomial. Minor fission product contamination does not prevent concentration determinations by XRFA. The computer-based system also allows real-time dynamic concentration measurements to be made.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 5469, 5472, 6078

5430 (INIS-mf—4765) **Handling final storage of unreprocessed spent nuclear fuel. I. General.** (Kaernbraenslesaekerhet, Stockholm (Sweden)). 1978. 111p. Dep. NTIS (US Sales Only), PC A06/MF A01.

The present second report from KBS describes how the safe final storage of spent unreprocessed nuclear fuel can be implemented. According to the Swedish Stipulation Law, the owner must specify in which form the waste is to be stored, how final storage is to be effected, how the waste is to be transported and all other aspects of fuel handling and storage which must be taken into

consideration in judging whether the proposed final storage method can be considered to be absolutely safe and feasible. Thus, the description must go beyond general plans and sketches. The description is therefore relatively detailed, even concerning those parts which are less essential for evaluating the safety of the waste storage method. For those parts of the handling chain which are the same for both alternatives of the Stipulation Law, the reader is referred in some cases to the first report. Both of the alternatives of the Stipulation Law may be used in the future. Handling equipment and facilities for the two storage methods are so designed that a combination in the desired proportions is practically feasible. In this first part of the report are presented: premises and data, a description of the various steps of the handling procedure, a summary of dispersal processes and a safety analysis.

5431 (NUREG/CR—0956) **Commentary on spent fuel storage at Morris operation.** Eger, K.J.; Zima, G.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 122p. (PNL—3065). Dep. NTIS, PC A06/MF A01.

The General Electric Company is providing technical support to Battelle Pacific Northwest Laboratories in the analysis of the design, operation, and maintenance experience in the handling of nuclear fuel at the Independent Spent Fuel Storage Facility. The purpose of this report is to provide a description of spent fuel handling activities and systems, and an analysis of the storage performance as developed over the seven year operational history of the Morris Operation. Design considerations and performance are analyzed for both the basin and key supporting systems. The bases for this analysis are the provisions for containing radioactive by-product materials, for shielding from the radiation they emit, and for preventing the formation of a critical array. These provisions have been met effectively over the history of storage at Morris. The release of radioactive materials is minimized by the protection of the cladding integrity, the containment of the basin water, the removal of radioactive and other contaminants from the water, and by filtering and then dispersing the basin air. Four auxiliary systems are provided to accomplish this, the basin leak detection system, the filter, the coolers, and the building ventilation system. This successful history notwithstanding, action to reduce personnel exposure, to improve fuel handling reliability and to lessen the potential for accidents continues to be taken.

5432 (PNL—2982) **Spent LWR fuel leach tests: Waste Isolation Safety Assessment program.** Katayama, Y.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 50p. Dep. NTIS, PC A03/MF A01.

Spent light-water-reactor (LWR) fuels with burnups of 54.5, 28 and 9 MWd/kgU were leach-tested in deionized water at 25°C. Fuel burnup has no apparent effect on the calculated leach rates based upon the behavior of ^{137}Cs and $^{239+240}Pu$. A leach test of 54.5 MWd/kgU spent fuel in synthetic sea brine showed that the cesium-based leach rate is lower in sea brine than in deionized water. A rise in the leach rate was observed after approximately 600 d of cumulative leaching. During the rise, the leach rate for all the measured radionuclides become nearly equal. Evidence suggests that exposure of new surfaces to the leachant may cause the increase. As a result, experimental work to study leaching mechanisms of spent fuel has been initiated. 22 figures.

5433 (RFP—2862) **National Waste Terminal Storage Program: containment system concepts for transporting Type B quantities of transuranic waste.** Rushton, R.J.; Merlini, R.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 14 Sep 1979. Contract EY-76-C-04-3533. 94p. Dep. NTIS, PC A05/MF A01.

A series of shipping containment system preliminary concepts for Type B quantities of transuranic waste have been formulated. The concepts were based on hypothetical accident protection requirements, potential waste forms, and selected hardware design/considerations. The concepts consist of suggested waste system containment configurations and construction material suggestions. Analysis of the concepts, based on such features as fabrication ease and cost, utility, and payload efficiency, revealed that concepts utilizing processed waste forms and/or disposable waste packages to provide a major portion of the required accident protection are most favorable.

5434 (RHO-C—25(Vol.2)(Draft)) **Dry Well Storage Facility conceptual design study: environmental assessment. Report No. 79-8-R.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations; Kaiser Engineers, Oakland, CA (USA)). Feb 1979. Contract EY-77-C-06-1030; EY-76-C-06-2195. 37p. Dep. NTIS, PC A03/MF A01.

The Dry Well Storage Facility will receive canisters (packages) containing spent fuel assemblies from a Spent Fuel Receiving and Packaging Facility or a Packaged Fuel Transfer Facility and store them in dry wells. The reference site for this study will be adjacent to the 200-W Area at the Hanford Reservation on a plateau approximately six miles from the Columbia River. This report discusses the potential nonradiological and radiological impacts on the environment due to construction, operation, and decommissioning of the facility.

5435 (RHO-LD—95) **Closure weld development for spent fuel canisters. Interim report.** Tignac, L.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1979. Contract EY-77-C-06-1030. 27p. Dep. NTIS, PC A03/MF A01.

In the spent fuel receiving and packaging facility, spent fuel assemblies would be enclosed within heavy-walled carbon steel canisters, and caps would be welded onto the canisters such that the sealed canisters would meet the intent of requirements for coded pressure vessels. The entire canister sealing operation, including welding and weld inspection, would normally be conducted remotely in a shielded hot-cell. A weld development activity was initiated to investigate canister sealing operations and to provide design criteria and bases for the spent fuel receiving and packaging facility and the canister. The activity plan included laboratory evaluation of welding processes and weld inspection techniques. Full-scale demonstrations were planned to evaluate, develop, and demonstrate the remote handling aspects of the operation. In February 1979, direction was received to suspend the weld development activity and to store its associated records and materials.

5436 (SAND—79-1929C) **Environmental effects associated with the transportation of radioactive material.** McClure, J.D.; Pope, R.B.; Yoshimura, H.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-791112—20). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

The primary aim of this paper has been to describe some of the background information concerning nuclear materials transportation systems, accident statistics, accident severities, and test information - all of which when combined yield an environmental statement of the risks associated with the transportation of radioactive materials. The results of the ultimate risk analysis are expressed in terms of numbers of fatalities and, in that sense at least, tend to be an absolute measure of risk. When these risks are compared with other accepted societal risks, the relative risks associated with radioactive material transportation can be established. This information can be used to make decisions at the governmental level and to inform an interested public about these risks. It can be concluded that the risks associated with the transportation of radioactive material are low relative to the other risks that society has already accepted.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5433, 5862, 6170

5437 (NUREG/CR—0685) **Characteristics of defense high-level waste.** Cheung, H.; Kniazewycz, B.G.; Kvam, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 May 1979. Contract W-7405-ENG-48. 68p. (UCRL—52704). Dep. NTIS, PC A04/MF A01.

This report presents a historical and technical review of the high-level radioactive waste management problems at Savannah River Plant, Hanford Reservation, and Idaho Chemical Processing Plant with major emphases on high-level waste inventory, characteristics, and management technologies. This information is presented for use as a portion of the defense high-level waste data base being developed to provide the US Nuclear Regulatory Commission with the necessary information to develop its regulatory framework and guidelines in this regard. 10 figures, 23 tables.

5438 (NUS—3383) **Power-reactor low-level radioactive waste generation and waste management practices evaluation. Report E. Policy recommendations, conclusions, and summary.** Feizollahi, F.; Stouky, R.J.; Connelly, J.M.; Jentz, T.L. (NUS Corp., Palo Alto, CA (USA)). Aug 1979. 80p. California Energy Commission, 1111 Howe Ave., Sacramento, CA 95825.

A study was conducted to evaluate nuclear waste management technology and to identify the problems that will have to be solved within the next few years in order to allow the orderly development of large-scale management of low-level radioactive wastes generated at nuclear power facilities and by the nuclear power industry in California. This volume provides a technical, economic, and environmental overview of waste management alternatives that could be pursued by the State of California. (DLC)

5439 (PNL—3036) **Stress analysis of high-level waste canisters: methods, applications, and design data.** Simonen, F.A.; Slate, S.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 156p. Dep. NTIS, PC A08/MF A01.

An overview of stress analysis methods, structural design procedures, and design data is presented for canisters used to package solidified wastes, particularly borosilicate glass. In addition,

waste processing, canister materials, fabrication and inspection methods, and performance testing are summarized. Sources of stress in canisters are lifting and handling loads, internal pressure, high-temperature filling operations, transient heating and cooling, differential thermal expansions of canisters and glass, and impact loadings from low-probability accidents. Results of case studies that illustrate applicable methods of stress analyses are presented for these sources of stress. Existing sections of ASME Boiler and Pressure Vessel Code are applicable to canister fabrication, but the code does not cover many aspects of canister service loadings. Specialized criteria for minimum wall thicknesses to sustain filling stresses are proposed in this report. Results of a test program to measure the creep strength of candidate canister materials are described. Methods to predict residual stresses in the walls of waste canisters are described; predicted residual stress levels agree with measured stress levels. The consequences of these residual stresses are reviewed, and stress-corrosion cracking is identified as the mode of canister failure affected by residual stresses. Canister-closure design is covered in detail, particularly the welding and inspection of the final closure seal-weld. It is shown that the methods of fracture mechanics and fatigue-crack-growth analyses are valuable tools for evaluating the performance of closure welds in the presence of crack-like defects. Canister performance in process trials at PNL shows the ability of canisters to survive high temperatures and loadings during processing. Impact tests show that a suitably designed canister can sustain severe impacts without loss of intergrity.

WASTE PROCESSING

5440 (COO—2510-15) **Advanced waste forms research and development. Final report, October 1, 1978-September 30, 1979.** McCarthy, G.J. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). Aug 1979. Contract EY-76-S-02-2510-092. 36p. Dep. NTIS, PC A03/MF A01.

Research on supercalcine-ceramics was conducted with the objectives of characterizing the phases and of applying them to fluorine-containing Thorex wastes. This report is concerned with quantitative phase analysis of complex ceramics using x-ray powder diffraction methods and with scanning transmission electron microscopy of these ceramics and its correlation with fluorite structure solid solution phase diagrams. (DLC)

5441 (EGG-RE-M—78-033) **Immobilization of INEL low-level radioactive wastes in ceramic containment materials.** Seymour, W.C.; Kelsey, P.V. (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1978. Contract EY-76-C-07-1570. 22p. Dep. NTIS, PC A02/MF A01.

INEL low-level radioactive wastes have an overall chemical composition that lends itself to self-containment in a ceramic-based material. Fewer chemical additives would be needed to process the wastes than to process high-level wastes or use a mixture containment method. The resulting forms of waste material could include a basalt-type glass or glass ceramic and a ceramic-type brick. Expected leach resistance is discussed in relationshp to data found in the literature for these materials and appears encouraging. An overview of possible processing steps for the ceramic materials is presented.

5442 (ENICO—1006) **Calcining sodium-bearing waste by blending with zirconium fluoride waste.** Newby, B.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Nov 1979. Contract AC07-79ID01675. 55p. Dep. NTIS, PC A04/MF A01.

A flowsheet, which is a method for converting wastes into granular, free flowing solids, was developed for calcining sodium-bearing waste stored at the Idaho Chemical Processing Plant (ICPP). The flowsheet consists of blending sodium-bearing waste with zirconium-fluoride waste so that the calcine product contains as much as 5% sodium; calcium nitrate is added to the blend to give a calcium-to-fluoride mole ratio of 0.7. 7 figures, 26 tables.

5443 (K/ET—5010) **Advances in the fluorocarbon process for decontamination of nuclear facility off-gas.** Kanak, B.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1979. Contract W-7405-ENG-26. 20p. (CONF-791144—1). Dep. NTIS, PC A02/MF A01.

From Annual MRS meeting; Boston, MA, USA (27 Nov 1979).

A selective adsorption process using R-12 was developed for removing noble gas fission products, ^{14}C, etc., from gaseous wastes of nuclear facilities. Its reliability has been proven by 10 years, operation of a 3-column process at ORGDP. A third generation pilot plant has undergone initial testing, which has showed that the combination column can perform essentially as well as the 3-column process. (DLC)

5444 (MLM—2667) **Commercial Cyclone Incinerator Demonstration Program: April-September 1979.** Alexander, B.M. (Mound Facility, Miamisburg, OH (USA)). 7 Dec 1979. Contract EY-76-C-04-0789. 11p. Dep. NTIS, PC A02/MF A01.

The commercial cyclone incinerator program was designed to study the effects of burning low-level waste contaminated with beta and gamma emitters in a cyclone system. The ultimate program goal is the demonstration of a cyclone incinerator at a nuclear power plant. During the past six months, the first program objective, NRC review of the Feasibility Plan, was achieved, and work began on the second objective, Complete Incinerator Feasibility Plan. Potential applications for the cyclone incinerator have been investigated. The feasibility plan for the incinerator system was reviewed with the Nuclear Regulatory Commission (NRC). Following a series of cold checkout burns, implementation of the feasibility plan was begun with the start of laboratory-scale experiments. Inconel 601 is being investigated as a material of construction for the incinerator burn chamber.

5445 (MLM—2672) **Defense waste cyclone incinerator demonstration program: April-September 1979.** Klingler, L.M. (Mound Facility, Miamisburg, OH (USA)). 14 Dec 1979. Contract EY-76-C-04-0053. 20p. Dep. NTIS, PC A02/MF A01.

Efforts to demonstrate the versatility of the Mound cyclone incinerator have continued during the last half of FY-1979. Design changes have been made or are in progress to correct known system problems. Work is being directed toward successfully demonstrating liquid burning and continuous feed burning. Preliminary test burning of liquid feed, scintillation vials, and LSA-type shredded solid waste have proved very encouraging. A preliminary conceptual design for a scintillation vial feed system has been prepared. Basic design criteria for a cyclone incinerator system to burn in a batch type mode have been published.

5446 (PNL—2925) **In-can melting process and equipment development from 1974 to 1978.** Blair, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 160p. Dep. NTIS, PC A08/MF A01.

Both the defense HLLW stores in tanks presently and the HLLW from proposed reprocessing of commercial LWR fuel can be vitrified as borosilicate glass in containers made of 300-series stainless steel by the ICM (in-can melting) process. Melting rates of 50 kg/h in 12-in.-dia cans and 117 kg/h in 28-in.-dia cans can be achieved in the ICM by using the rising-level charging method and internal heat-transfer plate assemblies in the cans. The ICM process can be monitored and remotely controlled without the aid of instrumentation attached to the waste can. The ICM process is compatible with both heated-wall spray calciners and fluidized-bed calciners. The ICM process causes residual tensile stresses as high as the yield strength in vitrified product containers made of 300-series stainless steel. Spall due to oxidation of the exterior of the can during an ICM process can be prevented by using an inert cover gas, by putting a protective coating on the can surface, or by using an oxidation-resistant alloy. Processing problems are minimized and product quality is improved when the complete can is located inside the furnace chamber by setting it on the hearth. A maximum of 24 kW and an average of 15 kW is required per 15-in.-high furnace zone to melt waste borosilicate glass at a rate of 117 kg/h in a 28-in.-dia ICM.

5447 (PNL—3181) **Characterization of gaseous and particulate effluents from the nuclear vitrification project.** Goles, R.W.; Hamilton, D.C.; Brauer, F.P.; Rieck, H.G. Jr.; Robertson, D.M.; Gordon, R.L.; Kaye, J.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 39p. Dep. NTIS, PC A03/MF A01.

Samples were taken during the second high-level liquid waste vitrification campaign associated with the NWVP. Sample analysis established the following total average emission levels in the undiluted vitrification off-gas stream: ^{3}H - 1.2 $\mu Ci/m^3$, ^{14}C - 0.2 $\mu Ci/m^3$, ^{129}I - 1 nCi/m^3, NO/sub x/ - 0.5%, ^{99}Tc - 1.6 pCi/m^3, and γ-emitters - $10^5(\gamma/s)/m^3$. The aerosol size distribution is composed almost entirely of particles exhibiting smaller diameters than the minimum value for which absolute filters are rated, with an empirical geometric mean diameter of 0.13 μm and a particle mass concentration of 84.7 pg/cm^3. The particulate matter was composed of ^{106}Ru, ^{125}Sb, /sup 125m/Te, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{154} ^{155}Eu and ^{241}Am. The particulate emission levels in the undiluted process off-gas stream were: ^{106}Ru - 44 nCi/m^3, ^{125}Sb - 0.52 nCi/m^3, /sup 125m/Te - 1.7 nCi/m^3, ^{134}Cs - 7.8 nCi/m^3, ^{137}Cs - 52 nCi/m^3, ^{144}Ce - 0.8 $\mu Ci/m^3$, ^{154}Eu - 0.3 nCi/m^3, ^{155}Eu - 0.18 nCi/m^3, and ^{241}Am - 0.19 nCi/m^3. All these environmental gaseous and airborne emissions level liquid waste were well within PNL waste management guidelines.

5448 **Comparison of anion exchange resins for recovering plutonium from nitric acid waste.** Navratil, J.D.; Martella, L.L. (Rockwell International, Golden, CO). *Nucl. Technol.;* **46**: No. 1, 105-109(Nov 1979).

Microreticular and macroreticular anion exchange resins were compared for their capability of recovering plutonium from nitric acid waste streams. Plutonium breakthrough capacity and elution behavior of the resins were determined as a function of resin properties. Small-bead microreticular resins with a polystyrene matrix containing 4% divinylbenzene cross-linkage showed the best performance. Of the 20- to 50-mesh resins, the macroreticular resin,

Amberlite IRA-938, gave the highest plutonium breakthrough capacity and eluted plutonium the fastest.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 5431, 5473, 6014, 6241, 6259, 6262, 6263, 6264, 6266, 6267

5449 (CONF-791103—42) **Subsurface-migration studies at the Radioactive Waste Management Complex, Idaho.** Humphrey, T.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 16p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Based on core drilling and subpit data, it appears that radionuclide migration has been restricted to a few centimeters below the waste and apparently poses no hazard to the Snake River Plain aquifer. Preliminary results of the modeling study tend to support this conclusion. The model does indicate, however, that some migration to the surface will occur over long periods of time.

5450 (CONF-791112—28) **Control of radionuclide migration in soil by the application of dc electric current.** Case, F.N.; Cutshall, N.H. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Shallow land burial in humid regions as a disposal method for low-level solid waste provides the potential for water-driven migration of leachable radionuclides present in the waste. A number of methods to control this migration have been suggested and studied. One such method involves the use of a dc electric current to move ions countercurrent to the water flow. Laboratory studies using trays of soil indigenous to the Oak Ridge National Laboratory (ORNL) low-level burial grounds have shown ^{137}Cs, ^{90}Sr, and ^{99}Tc ions can be moved countercurrent to a water flow using small dc currents of 20 mA at 40 volts. A field test of the method has been under way for over one year in an ORNL low-level waste disposal area. Results of the field test are given in this paper.

5451 (DOE/EIS—0023) **Final environmental impact statement. Long-term management of defense high-level radioactive wastes (research and development program for immobilization), Savannah River Plant, Aiken, South Carolina.** (Department of Energy, Washington, DC (USA)). Nov 1979. 304p. Dep. NTIS, PC A14/MF A01.

The present statement explores the environmental implications of a large research and development (R and D) program aimed at developing the proposed continuation of technology for removing the wastes from the tanks and immobilizing the radionuclides in solid forms for subsequent disposal. The proposed R and D program is directed toward developing technology for converting the waste into two fractions: a durable waste form containing over 99% of the radioactivity, and decontaminated salt, with storage or disposal of the waste form, e.g., in an off-site geological repository, an on-site surface storage vault, or an on-site geological repository (bedrock cavern) and storage of the salt in: decontaminated waste tanks at SRP, an on-site surface vault, or an off-site geologic repository. The following alternatives to the proposed immobilization R and D program are assessed for environmental impact: continue storing high-level waste in subsurface storage tanks, which is a continuation of the present management practice, or, slurry the high-level waste into bedrock caverns, an on-site geological repository. (This alternative has been designated as environmentally unacceptable by the US EPA).

5452 (FBDU—289-01) **Engineering study of stored waste retrieval at Idaho National Engineering Laboratory.** Baird, R.D.; Hill, F.J.; Hunter, P.H.; Rich, D.C.; Ricks, B.L.; Robertson, B.C.; Thomas, J.E. (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Sep 1979. Contract EY-76-C-07-1570. 156p. Dep. NTIS, PC A08/MF A01.

A large quantity of transuranic waste is currently stored at the Transuranic Storage Area (TSA) at the Idaho National Engineering Laboratory. It is anticipated that a Slagging Pyrolysis Incinerator (SPI) will be constructed near the TSA to process this waste. The study described identifies design criter, provides a preliminary conceptual system design and performs engineering analyses of various strategies for retrieving waste from the TSA and delivering it to the SPI.

5453 (LA-UR—79-2992) **Paramenters affecting radionuclide migration in geologic media.** Erdal, B.R.; Bayhurst, B.P.; Daniels, W.R. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-791112—23). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Adsorption of several nuclides (Sr, Tc, Cs, Ba, Ce, Eu) on tuff, monzonite, and argillite was studied experimentally. 3 tables. (DLC)

5454 (LBL—7083) **Characterization of discontinuities in the Stripa granite. Time-scale heater experiment.** Thorpe, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 110p. Dep. NTIS, PC A06/MF A01.

The report describes the methodology and results of a detailed study of geologic discontinuities associated with the time-scale heater test at the Stripa mine in Sweden. Mapping of the floor of the experiment tunnel coupled with observation of core samples from beneath the drift indicate that four N-striking shear fractures dip steeply through the 6 x 10 x 25-m rock mass. Oblique-thrust faulting has produced displacements of up to 2 m on one of the surfaces, and its inferred 3-D configuration is consistent with observed slickensiding. Resolution of locally measured principal stresses on the shear plane yields a theoretical shear direction that also coincides with the slickensiding. Four distinct joint sets exist locally, one of which coincides with the shear fractures. Another lies nearly horizontal, and two others are steeply inclined. Fracture length and spacing distributions for the four joint sets are shown to be lognormal. Two of the sets lie perpendicular to principal stress directions. The fact that one of these two joint sets apparently post-dates other fracturing and is normal to the minimum principal stress suggests that it is due to isostatic rebound.

5455 (ORNL/TM—7112) **Comparison of the results of several heat transfer computer codes when applied to a hypothetical nuclear waste repository.** Claiborne, H.C.; Wagner, R.S.; Just, R.A. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 69p. Dep. NTIS, PC A04/MF A01.

A direct comparison of transient thermal calculations was made with the heat transfer codes HEATING5, THAC-SIP-3D, ADINAT, SINDA, TRUMP, and TRANCO for a hypothetical nuclear waste repository. With the exception of TRUMP and SINDA (actually closer to the earlier CINDA3G version), the other codes agreed to within +-5% for the temperature rises as a function of time. The TRUMP results agreed within +-5% up to about 50 years, where the maximum temperature occurs, and then began an oscillary behavior with up to 25% deviations at longer times. This could have resulted from time steps that were too large or from some unknown system problems. The available version of the SINDA code was not compatible with the IBM compiler without using an alternative method for handling a variable thermal conductivity. The results were about 40% low, but a reasonable agreement was obtained by assuming a uniform thermal conductivity; however, a programming error was later discovered in the alternative method. Some work is required on the IBM version to make it compatible with the system and still use the recommended method of handling variable thermal conductivity. TRANCO can only be run as a 2-D model, and TRUMP and CINDA apparently required longer running times and did not agree in the 2-D case; therefore, only HEATING5, THAC-SIP-3D, and ADINAT were used for the 3-D model calculations. The codes agreed within +-5%; at distances of about 1 ft from the waste canister edge, temperature rises were also close to that predicted by the 3-D model.

5456 (PB—293403) **Information base for waste repository design. Volume 3. Waste/rock interactions. Technical report.** Koplik, C.M.; Oston, S.G.; Pentz, D.L.; Talbot, R. (Analytic Sciences Corp., Reading, MA (USA)). Mar 1979. Contract NRC-02-77-129. 137p. NTIS, PC AA07/MF A01.

This report is Volume 3 of a seven volume document on nuclear waste repository design issues. This report describes the important effects resulting from interaction between radioactive waste and the rock in a nuclear waste repository. The state-of-the-art in predicting waste/rock interactions is summarized. Where possible, independent numerical calculations have been performed. Recommendations are made pointing out areas which require additional research.

5457 (PNL-SA—7897) **Mathematical simulation for safety assessment of nuclear waste repositories.** Brandstetter, A.; Raymond, J.R.; Benson, G.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 24p. (CONF-790994—1). Dep. NTIS, PC A02/MF A01.

From 26. Pacific Northwest regional meeting of the American Geophysical Union; Bend, OR, USA (17 Sep 1979).

Mathematical models are being developed as part of the Waste Isolation Safety Assessment Program (WISAP) for assessing the post-closure safety of nuclear waste storage in geologic formations. The objective of this program is to develop the methods and data necessary to determine potential events that might disrupt the integrity of a waste repository and provide pathways for radionuclides to reach the bioshpere, primarily through groundwater transport. Four categories of mathematical models are being developed to assist in the analysis of potential release scenarios and consequences: (1) release scenario analysis models; (2) groundwater flow models;

(3) contaminant transport models; and (4) radiation dose models. The development of the release scenario models is in a preliminary stage; the last three categories of models are fully operational. The release scenario models determine the bounds of potential future hydrogeologic changes, including potentially disruptive events. The groundwater flow and contaminant transport models compute the flowpaths, travel times, and concentrations of radionuclides that might migrate from a repository in the event of a breach and potentially reach the biosphere. The dose models compute the radiation doses to future populations. Reference site analyses are in progress to test the models for application to different geologies, including salt domes, bedded salt, and basalt.

5458 (RHO-BWI-CD—2(Rev.1)) **Nuclear waste repository in basalt: preconceptual design guidelines.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1979. Contract EY-77-C-06-1030. 192p. Dep. NTIS, PC A09/MF A01.

The development of the basalt waste isolation program parallels the growing need for permanent, environmentally safe, and secure means to store nuclear wastes. The repository will be located within the Columbia Plateau basalt formations where these ends can be met and radiological waste can be stored. These wastes will be stored such that the wastes may be retrieved from storage for a period after placement. After the retrieval period, the storage locations will be prepared for terminal storage. The terminal storage requirements will include decommissioning provisions. The facility boundaries will encompass no more than several square miles of land which will be above a subsurface area where the geologic makeup is primarily deep basaltic rock. The repository will receive, from an encapsulation site(s), nuclear waste in the form of canisters (not more tnan 18.5 feet x 16 inches in diameter) and containers (55-gallon drums). Canisters will contain spent fuel (after an interim 5-year storage period), solidified high-level wastes (HLW), or intermediate-level wastes (ILW). The containers (drums) will package the low-level transuranic wastes (LL-TRU). The storage capacity of the repository will be expanded in a time-phased program which will require that subsurface development (repository expansion) be conducted concurrently with waste storage operations. The repository will be designed to store the nuclear waste generated within the predictable future and to allow for reasonable expansion. The development and assurance of safe waste isolation is of paramount importance. All activities will be dedicated to the protection of public health and the environment. The repository will be licensed by the US Nuclear Regulatory Commission (NRC). Extensive efforts will be made to assure selection of a suitable site which will provide adequate isolation.

5459 (SAND—79-0279) **Basic data report for drillhole WIPP 25 (Waste Isolation Pilot Plant - WIPP).** (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 62p. Dep. NTIS, PC A04/MF A01.

WIPP 25 was drilled on the eastern edge of Nash Draw (SW 1/4, Sec. 15, T22S, R30E) in Eddy County, New Mexico, to determine subsurface stratigraphy and examine dissolution features above undisturbed salt in the Salado Formation. Determination of dissolution rates will refine previous estimates and provide short-term (geologically) rates for WIPP risk assessments. The borehole encountered, from top to bottom, Pleistocene sediments (17 ft with fill material for pad), Dewey Lake Red Beds (215 ft, Rustler Formation (333 ft, and 90 ft of the upper Salado Formation. A dissolution residue, 37 ft thick, is at the top of the Salado Formation overlying halite-rich beds. In addition to obtaining nearly continuous core from the surface to total depth (655 ft, geophysical logs were taken to measure acoustic velocities, density, radioactivity, and formation resistivity. An interpretive report on dissolution in Nash Draw will be based on combined borehole basin data, surface mapping, and laboratory analyses of Nash Draw rocks and fluids. The WIPP is to demonstrate (through limited operations) disposal technology for transuranic defense wastes and to then be converted to a repository. The WIPP will also provide research facilities for interactions between high-level waste and salt.

5460 (SAND—79-0911C) **Gas generation from transuranic waste degradaton.** Molecke, M.A. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 9p. (CONF-791112—21). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Based on experimental data the relative quantities of gas generated by individual mechanism for existing forms of TRU-contaminated wastes under expected WIPP environmental conditions are ranked in order as: (1) BACTERIAL (greatest potential, but large variability); (2) THERMAL (at 40°C; probably insignificant at 25°C); (3) RADIOLYSIS (most predictable; potential short-term risks); (4) CORROSION (under the dry conditions expected in WIPP); and (5) ALPHA DECAY (insignificant). Results indicate that waste processing to minimize such gas generation is not technically required.

5461 (SAND—79-0954C) **Mechanism for elevated temperature leaching.** Kenna, B.T.; Murphy, K.D. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-791112—31). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Long-term, elevated temperature leaching and subsequent electron microprobe analysis of simulated waste glass and ceramic materials have been completed. A cyclic leaching pattern was found in all systems over a 20-month period. It appears that the leaching of mobile ions by simple diffusional processes is modified by more complex chemical interactions. The release of immobile ions is primarily a function of their chemical interactions in the matrix which suggests that these ions may be complex species when released into solution. A mechanism is proposed which incorporates these ideas and the cyclic phenomenon observed.

5462 (SAND—79-0990C) **Backfill as an engineered barrier for nuclear waste management.** Nowak, E.J. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-791112—42). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Portions of document are illegible.

The swelling, plastic flow, and relative impermeability of bentonite and hectorite were observed and measured after wetting with concentrated brines. Measurements of stable values of pH > 6.5 for the interstitial brines in wetted bentonite and hectorite confirmed conditions favorable for precipitation and sorption of transuranics. Values of K/sub d/ > 2000 ml/g were measured for Pu and Am. Calculated estimates of the effectiveness of a one-foot-thick backfill barrier are presented. They show that the breakthrough of Pu and other transuranics (K/sub d/ = 2000 ml/g) can be delayed for 10^4 to 10^5 years. The breakthrough of most fission products (K/sub d/ = 200 ml/g) can be delayed for 10^3 to 10^4 years, sufficient time for them to decay to very low concentrations. A backfill barrier can contribute significantly to a radioactive waste isolation system.

5463 (SAND—79-1019C) **Interaction of radionuclides with geomedia from the Nevada Test Site.** Lynch, A.W.; Dosch, R.G. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-791112—34). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Aqueous/solid distribution coefficients have been measured for ^{137}Cs, ^{85}Sr, ^{99}Tc, ^{152}Eu, ^{144}Ce, ^{238}Pu, ^{243}Am and ^{244}Cm on powdered argillite and hornfels obtained from the Nevada Test Site. The fluid phases included a groundwater simulant and deionized water preequilibrated with powdered argillite. Distribution coefficients for lanthanides and actinides are generally high and Eleana shale was found to effectively sorb technetium.

5464 (SAND—79-1076C) **Perspective of waste isolation research issues and assessment of consequences for radionuclide release.** Hunter, T.O. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-791112—29). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

The finiteness of research resources to address technical issues for nuclear waste management requires a realistic assessment of their importance. The most appropriate method for making this assessment is the combination of system studies, which include consideration of the role of all protective barrier, and consequence assessment models that can estimate the potential hazard imposed upon man for assumed violations of these barriers. Sensitivity analyses on certain issues can then be performed to determine the impact of various descriptive parameters. Work commensurate with this strategy has been initiated at Sandia. Some conclusions drawn from these studies specifically applicable to WIPP for the scenarios considered are that: Waste form and protective canisters are not essential as barriers. Assumed radionuclide dissolutioning is far in excess of that possible with developmental waste forms. Brine migration plays no significant role in long-term isolation; complications to retrievability can be avoided with numerous technical alternaives. Radionuclide sorption in geomedia near repositories plays an important role in reducing consequences, but sites with favorable geologic and hydrologic settings such as WIPP can tolerate essentially no reliance on sorption and still achieve inconsequential predicted doses. Plutonium sorption with K/sub d/ greater than 10 are sufficient to eliminate direct doses from plutonium. Borehole plugs are not required for primary protection. Continued scientific resolution of both real and perceived issues can, however, provide additional assurance and public confidence that consequences can be reduced beyond those predicted in bounding scenarios. In addition, such investigation will assure that appropriate limits are instituted for defining parameters and that all assumptions in predictive models are technically sound.

5465 (SAND—79-1855) **Conasauga near-surface heater experiment. Final report.** Krumhansl, J.L. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 98p. Dep. NTIS, PC A05/MF A01.

The Conasauga Experiment was undertaken to begin assessment of the thermomechanical and chemical response of a specific shale to the heat resulting from emplacement of high-level nuclear wastes. Canister-size heaters were implanted in Conasauga shale in Tennessee. Instrumentation arrays wee placed at various depths in drill holes around each heater. The heaters operated for 8 months and, after the first 4 days, were maintained at 385°C. Emphasis was on characterizing the thermal and mechanical response of the formation. Conduction was the major mode of heat transport; convection was perceptible only at temperatures above the boiling point of water. Despite dehydration of the shale at higher temperatures, in situ thermal conductivity was essentially constant and not a function of temperature. The mechanical response of the formation was a slight overall expansion, apparently resulting in a general decrease in permeability. Metallurgical observations were made, the stability of a borosilicate glass wasteform simulant was assessed, and changes in formation mineralogy and groundwater composition were documented. In each of these areas, transient nonequilibrium processes occur that affect material stability and may be important in determining the integrity of a repository. In general, data from the test reflect favorably on the use of shale as a disposal medium for nuclear waste.

5466 (SAND—79-1902) **Instrumentation development for the Waste Isolation Pilot Plant (WIPP) borehole plugging program (BHP).** Cook, C.W. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 17p. Dep. NTIS, PC A02/MF A01.

This report discusses the instrumentation development needs of the borehole testing program as it now exists. Although requirements may change as the program progresses, the items indicated are basic to any borehole plugging program. Instrumentation is discussed both for the plug environment and for the plug itself. For the plug environment, a probe for measuring the disturbed region and a coordinate logging tool are required. For the plug itself, instrumentation includes measurements above, within, and below the plug. Instrumentation for most measurements above the plug is currently available; for measurements within and below the plug, however, further development is required. Specifically, resistivity, induction, and acoustic probes; an in situ stressmeter; and a hardwire, feedthrough system need to be developed.

5467 (SAND—79-1959C) **Waste Isolation Pilot Plant (WIPP) release scenarios.** Brannen, J.P. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 11p. (CONF-791087—1). Dep. NTIS, PC A02/MF A01.

From US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing; Berlin, F.R. Germany (1 Oct 1979).

The selection of release scenarios utilized in the assessment of the Waste Isolation Pilot Plant (WIPP) performance studies is discussed. The first scenario selected was an uncased 9" borehole penetrating the Rustler Formation, the Repository, and the Bell Canyon Aquifer. The second scenario selected was described as a U tube scenario. It postulated events which lead to a flow from the Rustler Formation through the Repository then back to the Rustler Formation. The third scenario selected covered the formation of a nonflowing communication between the Repository and the Rustler Formations. Here the movement of radionuclides is up the salinity gradient by molecular diffusion. The last scenario assumed that at some future date, a drill crew cored through a cannister and brought the material to the surface.

5468 (SAND—79-7042) **Meteorological and air quality data quarterly report WIPP site: Eddy County, New Mexico. Winter quarter, December 1976-February 1977.** Pocalujka, L.P.; Babij, E.; Church, H.W. (TRC, Inc., Wethersfield, CT (USA); Sandia Labs., Albuquerque, NM (USA)). Aug 1979. Contract EY-76-C-04-0789. 216p. Dep. NTIS, PC A10/MF A01.

The Wipp meteorological, air quality, and radiological measurements program was implemented to support the environmental effort for the evaluations of the site selection suitability. This data report is the third of a series of seasonal quarterly data summaries to be issued for the southeastern New Mexico site.

5469 (UCRL—15111) **Retrieval system for emplaced spent unreprocessed fuel (SURF) in salt bed depository: accident event analysis and mechanical failure probabilities. Final report.** Bhaskaran, G.; McCleery, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 250p. Dep. NTIS, PC A11/MF A01.

This report provides support in developing an accident prediction event tree diagram, with an analysis of the baseline design concept for the retrieval of emplaced spent unreprocessed fuel (SURF) contained in a degraded Canister. The report contains an evaluation check list, accident logic diagrams, accident event tables, fault trees/event trees and discussions of failure probabilities for the following subsystems as potential contributors to a failure: (a) Canister extraction, including the core and ram units; (b) Canister transfer at the hoist area; and (c) Canister hoisting. This report is the second volume of a series. It continues and expands upon the report Retrieval System for Emplaced Spent Unreprocessed Fuel (SURF) in Salt Bed Depository: Baseline Concept Criteria Specifications and Mechanical Failure Probabilities. This report draws upon the baseline conceptual specifications contained in the first report.

5470 (UCRL—83488) **Computer modeling of nuclear waste storage canister corrosion.** Cottrell, P.T.; Ludemann, W.D.; McCright, R.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Oct 1979. Contract W-7405-ENG-48. 11p. (CONF-791112—25). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Current plans for nuclear waste disposal include placing the waste in a canister to isolate it from the repository environment for 1000 years. Corrosion prediction techniques are currently inadequate to quarantee the canister performance over this length of time. We are attempting to better predict the corrosion process with the help of computer modeling. We developed a program to calculate anodic and cathodic polarization curves using Tafel slopes, equilibrium exchange current densities, and other electrochemical parameters obtained from the experimental corrosion literature. The model generates and displays polarization curves for different values of environmetal parameters such as temperature, pH, and concentrations of pertinent species in the vicinity of the canister material. For the case of uniform corrosion in acidic media, our model predicts corrosion rates in fair agreement with literature values.

5471 **Leakage detection system for radioactive waste storage tanks.** Woods, W.W.; Eul, W.A. (to The Boeing Co.). US Patent 4,166,244. 28 Aug 1979. Filed date 19 Nov 1976. 12p.

The patent describes a combination of elements for detecting leakage of electrically conductive fluids from tanks, including a reference electrode, an AC generator connected between the tank and the reference electrode, and one or more sensing electrodes positioned between the tank and the reference electrode. The storage tank and reference electrode are in contact with the ground. When the AC generator is energized, current flows in the circuit, and creates an electric field in the ground between the tank and the reference electrode. The sensing electrodes are positioned so that they are within the electric field when the AC generator is energized. An electric potential measuring device, such as a voltmeter, is used to measure the electric potential at the sensing electrodes relative to the tank. A significant change in the electric potential at any one or more of the sensing electrodes is an indication that a leak has occurred in the tank.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5434, 5447, 5450, 5453, 5457, 5464, 5467, 5468, 6170, 6244

5472 (DOE/EV—0005/16) **Formerly utilized MED/AEC sites Remedial Action Program. Radiological survey of the St. Louis Airport Storage Site, St. Louis, Missouri. Final report.** (Oak Ridge National Lab., TN (USA)). Sep 1979. Contract W-7405-ENG-26. 122p. Dep. NTIS, PC A06/MF A01.

Results of two radiological surveys of the St. Louis-Lambert Airport property, formerly known as the Airport Storage Site, St. Louis, Missouri, are presented. Uranium- and radium-bearing waste materials were stored from the 1940's to the late 1960's in this area. The surveys included direct measurements of beta-gamma radiation; determination of uranium, actinium, and radium concentrations in soil samples and from bore holes; determination of radionuclide concentrations in groundwater and surface water; measurement of radon flux from the ground surface; and measurements of ^{222}Rn in air near the site. Results indicate that some offsite drainage pathways are becoming contaminated, probably by runoff from the site; no migration of ^{222}Rn from the site was observed.

5473 (PNL-SA—7875) **Numerical analysis of radionuclide movement from a hypothetical nuclear waste repository.** Raymond, J.R.; Segol, G. (Battelle Pacific Northwest Labs., Richland, WA (USA); Bechtel National, Inc., San Francisco, CA (USA)). 1979. Contract EY-76-C-06-1830. 27p. Dep. NTIS, PC A03/MF A01.

A numerical analysis of the consequences of radionuclide release from a hypothetical nuclear waste repository located in bedded salt and of their subsequent transport by ground water has been performed. The study was based on available geologic and hydrologic information for the reference location. The initial run was based on a best estimate of geologic and hydrologic paramcters for this reference location. Its results indicate that those isotopes which reach the natural discharge point remain below MPC levels

for uncontrolled water use. The initial run was followed by a parametric study to evaluate the sensitivity of the model to the values of input parameters. This analysis shows that the model is sensitive to the assumed values of hydraulic conductivity, dispersivity and retardation factor, as expected. But this analysis also emphasizes that there exist complex interactions between such parameters which are less intuitively evident. The influence of waste leach rates is being investigated.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 5409, 5436, 5449, 5457, 5461, 5463, 5469

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 5429, 6028

5474 (LA—7991-PR) **Nuclear safeguards research and development. Program status report, April-June 1979.** Gardner, S.D. (ed.). (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Co ·tract W-7405-ENG-36. 53p. Dep. NTIS, PC A04/MF A01.

This report presents the status of the Nuclear Safeguards Research and Development program pursued by the Los Alamos Scientific Laboratory Safeguards Groups Q-1, Q-2, Q-3, Q-4, and Q-5. Topics covered include nondestructive assay technology development and applications, international safeguards, perimeter safeguards and surveillance, concepts and subsystems development (e.g., DYMAC program), integrated safeguards systems, training courses, and technology transfer.

5475 (NUREG/CR—1102) **Systematic assessment of the safeguards regulations. Summary.** Fraley, D.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 35p. (PNL—2804(Vol.1)). Dep. NTIS, PC A03/MF A01.

In this study, systematic analysis methods are used to assess the content and relative coverage of present physical protection and material control and accounting regulations. Regulatory requirements are examined to determine if they are responsive to safeguards policy, consistent, complete, and do not contradict or render ineffective other safeguards, public safety, or worker safety requirements.

5476 (ORAU/IEA—79-18(R)) **International acceptability of advanced safeguarding techniques.** Barkenbus, J.N. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Sep 1979. Contract EY-76-C-05-0033. 60p. Dep. NTIS, PC A04/MF A01.

There are active development programs now under way to significantly enhance the effectiveness of international safeguarding. Advanced safeguarding techniques now under development include new material accounting methods utilizing nondestructive assay techniques, more reliable surveillance instrumentation, tamper-resistant and tamper-indicating seals, new means of utilizing continuous human inspection, and systems that incorporate both passive and active use-denial technologies. Before these new safeguarding techniques are utilized, however, they must be acceptable to the international community. This will unquestionably result in a compromise between what is technically feasible and what is politically acceptable. This report highlights many of the elements common to advanced safeguarding techniques that impact directly upon international acceptability. The concept of acceptability is viewed from the perspective of three different groups: (1) those States seeking upgraded safeguards, (2) those States having safeguards imposed upon them, and (3) the International Atomic Energy Agency. In general, a more conducive climate exists today for the acceptance of advanced safeguarding techniques than at any period in the past; but the differences between advanced safeguards and those safeguards being employed today are so large that considerable opposition to their implementation can be expected.

5477 (SAND—79-1071C) **Tamper recorder for unattended safeguards instruments.** Smathers, D.C. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 5p. (CONF-791117—16). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

The Secure Counter Panel is an electro-mechanical module which records attempts to tamper with instruments of an unattended safeguards system in a way which cannot be sabotaged or bypassed without leaving obvious evidence of tampering. A number of novel tamper-safing techniques are included in the design, some of which are widely applicable to other safeguards instruments.

5478 (SAND—79-2225C) **Goals of measurement systems for international safeguards.** de Montmollin, J.M.; Weinstock, E.V. (Sandia Labs., Albuquerque, NM (USA); Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-04-0789. 18p. (CONF-791117—9). Dep. NTIS, PC A02/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

The safeguards applied by the International Atomic Energy Agency are based on technical performance goals and criteria that have been developed, but not officially adopted by the Agency. The goals derive in part from the external consequences that safeguards are intended to prevent and in some cases on internal considerations of feasibility. To the extent that these goals may not be attainable, as may be the case with large-throughput bulk reprocessing plants, the Agency is placed in a difficult position. In this paper safeguards goals and criteria and their underlying rationales are critically examined. Suggestions for a more rational and workable structure of performance goals are offered.

5479 **Analysis of MUF data using arima models.** Downing, D.J.; Pike, D.H.; Morrison, G.W. (Oak Ridge Natl Lab, Tenn). *Nucl. Mater. Manage.;* 7: No. 4, 80-86(1978).

An introduction to Box-Jenkins time series analysis is presented. It is shown how the models presented by Box-Jenkins can be applied to material unaccounted for (MUF) data to detect losses. For the constant loss case an optimal estimate of the loss is found and its probability of detection found.

5480 **Materials safeguards and accountability in the low enriched uranium conversion-fabrication sector of the fuel cycle.** Schneider, R.A.; Nilson, R.; Jaech, J.L. (Exxon Nucl Co, Richland, Wash). *Nucl. Mater. Manage.;* 7: No. 4, 109-116(1978).

Today materials accounting in the low enriched conversion-fabrication sector of the LWR fuel cycle is of increased importance. Low enriched uranium is rapidly becoming a precious metal with current dollar values in the range of one dollar per gram comparing with gold and platinum at 7-8 dollars per gram. In fact, people argue that its dollar value exceeds its safeguards value. Along with this increased financial incentive for better material control, the nuclear industry is faced with the impending implementation of international safeguards and increased public attention over its ability to control nuclear materials. Although no quantity of low enriched uranium (LEU) constitutes a practical nuclear explosive, its control is important to international safeguards because of plutonium production or further enrichment to an explosive grade material. The purpose of the paper is to examine and discuss some factors in the area of materials safeguards and accountability as they apply to the low enriched uranium conversion-fabrication sector. The paper treats four main topics: basis for materials accounting; our assessment of the proposed new IAEA requirements; adequacy of current practices; and timing and direction of future modifications.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 5791, 5862

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

5481 **X- and Y-axis driver for rotating microspheres.** Weinstein, B.W. (to Dept. of Energy). US Patent 4,157,490. 5 Jun 1979. Filed date 17 May 1978. 4p.

PAT-APPL-906,818.

Apparatus for precise control of the motion and position of microspheres for examination of their interior and/or exterior. The apparatus includes an x- and y-axis driver mechanism controlled, for example, by a minicomputer for selectively rotating microspheres retained between a pair of manipulator arms having flat, smooth end surfaces. The driver mechanism includes an apertured plate and ball arrangement which provided for coupled equal and opposite movement of the manipulator arms in two perpendicular directions. 5 claims.

5482 **Method for forming targets.** Woerner, R.L. (to Dept. of Energy). US Patent 4,154,868. 15 May 1979. Filed date 13 Jul 1978. 8p.

PAT-APPL-924,335.

A method is described for cryoinduced uniform deposition of cryogenic materials, such as deuterium-tritium (DT) mixtures, on the inner surface of hollow spherical members, such as inertially imploded targets. By vaporizing and quickly refreezing cryogenic materials contained within a hollow spherical member, a uniform

layer of the materials is formed on the inner surface of the spherical member. Heating of the cryogenic material, located within a non-isothermal compact freezing cell, is accomplished by an electrical heat pulse, whereafter the material is quickly frozen forming a uniform layer on the inner surface of the spherical member. The method is not restricted to producing a frozen layer on only the inner surface of the innermost hollow member, but where multiple concentric hollow spheres are involved, such as in multiple shell targets for lasers, electron beams, etc., layers of cryogenic material may also be formed on the inner surface of intermediate or outer spherical members, thus providing the capability of forming targets having multiple concentric layers of shells of frozen DT. 7 claims.

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 6006

HYDROGEN

PRODUCTION

5483 (COO—4258-2) **Hydrogen and methane syntheses through radiation catalysis. Progress report, September 1, 1978-August 1, 1979.** (Colorado Energy Research Inst., Golden (USA)). Sep 1979. Contract EG-77-C-02-4258. 53p. Dep. NTIS, PC A04/MF A01.

Results of the second contract year are described on production of hydrogen through water radiolysis at ^{60}Co gamma energies, in the presence of solid oxide catalysts. The intent of the research is an improved theoretical understanding of radiation-induced hydrogen generation within the framework of the electronic theory of catalysis. Correlation of hydrogen yield with catalytic activity, based on prior work, was difficult to attain and an assessment of experimental parameters was made. Three sets of observations appear of some significance, however: (1) Antimony oxide (Sb_2O_3, Eg = 3.3) shows consistently a dramatic increase in catalytic performance which cannot be attributed solely to band gap values. (2) There appears to be a correlation between hydrogen yield and dielectric properties of the catalyst. (3) Gamma irradiation changes the constitutive electrical properties of oxide catalyts in a manner proportional to hydrogen yields. Subsequent research will examine items 1, 2, and 3 more fully. It will also evaluate quantitatively the utility of the theoretical model.

THERMOCHEMICAL PROCESSES

5484 (LA—7937-PR) **Thermochemical processes for hydrogen production. Progress report, October 1, 1978-March 31, 1979.** Cox, K.E. (comp.). (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract W-7405-ENG-36. 23p. Dep. NTIS, PC A02/MF A01.

The work described in this report was accomplished during the period October 1, 1978-March 31, 1979, on a DOE-sponsored program aimed at developing efficient and economic thermochemical cycles for hydrogen production from a variety of high-temperature energy sources such as fusion, fission, and solar energy. Most of the effort was applied to a study of the Los Alamos Scientific Laboratory (LASL) hybrid bismuth sulfate cycle. The work included a conceptual design of the cycle, made to obtain performance parameters, and experimental work done to verify the design conditions. A 50% efficiency was obtained when an improved cycle design was coupled to a fusion energy source at 1500°K. The improved design was based on a reduction endothermic requirement for $Bi_2O_3 \cdot 2SO_3$ decomposition and a lower voltage for SO_2 electrolysis that should result at lower acid concentrations. Experimental results showed an endothermic heat requirement of +172 kJ/mol for the decomposition of $Bi_2O_3 \cdot 2SO_3$ to $Bi_2O_3 \cdot SO_3$ and SO_3. Reaction times for bismuth sulfate decomposition were determined as a function of temperature. At 1240 K, ~1.5 min were required for the first two stages of decomposition from $Bi_2O_3 \cdot 3SO_3$ to $Bi_2O_3 \cdot SO_3$. In tests made to determine the feasibility of decomposing $Bi_2O_3 \cdot 2SO_3$ in a fluidized bed, the solid particles agglomerated when heated. Solid particles suitable for fluidization will be sought through new approaches.

INDUSTRIAL AND COMMERCIAL USE

5485 **Hydrogen-powered vs battery-powered automobiles.** Donnelly, J.J. Jr. (Aerospace Corp., El Segundo, CA); Escher, W.J.D.; Ecklund, E.E.; Greayer, W.C.; Nichols, R.J. *Int. J. Hydrogen Energy;* **4**: No. 5, 411-443(1979).

Two future candidate automobile propulsion systems which do not rely upon petroleum or natural gas as an energy source have been studied, and the resultant vehicle characteristics have been identified. The first vehicle system employs a gaseous hydrogen-fueled internal combustion engine (ICE) and either a liquid or metal hydride energy storage system. The second vehicle system employs an electronically controlled electric motor power train and a battery energy storage system. Major tasks included in this study were the technical and economic assessments of the state of the art and future alternatives in hydrogen production and delivery, the hydrogen vehicle assessment, the battery-electric vehicle assessment, and the comparision of the principal vehicle alternative in 1985, 1990 and 2000. The comparison includes weight, size, cost, energy and design range relationships and the implications on expenditure of all major energy sources. The study is summarized, results are presented, and conclusions are drawn. Comments are made on the future roles of hydrogen and electricity in automobile propulsions.

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 5310

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 5292, 5494, 6214

5486 (ANL/EES-TM—58) **Environmental and economic evaluations of energy recovery from agricultural and forestry residues.** Harper, J.P.; Antonopoulos, A.A.; Sobek, A.A. (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 117p. Dep. NTIS, PC A06/MF A01.

Agricultural and forestry residues have been converted to energy for centuries. The technologies employed range from straightforward approaches such as combustion to produce heat to more involved approaches such as pyrolysis of the residues to produce medium-Btu synthetic gas, charcoal, and oil. Thus there is no one technology that can be characterized as the best or most promising for conversion of agricultural and forestry residues into energy. Therefore, to accurately assess the potential of agricultural and forestry residues as energy resources, an array of current conversion options should be addressed. Four conversion methods and five residues are examined in this report, which describes six model systems: hydrolysis of corn residues, pyrolysis of corn residues, combustion of cotton-ginning residues, pyrolysis of wheat residues, fermentation of molasses, and combustion of pulp and papermill wastes. Estimates of material and energy flows for those systems are given per 10^{12} Btu of recovered energy. Regional effects are incorporated by addressing the regionalized production of the residues. A national scope cannot be provided for every residue considered because of the biological and physical constraints of crop production. Thus, regionalization of the model systems to the primary production region for the crop from which the residue is obtained has been undertaken. The associated environmental consequences of residue utilization are then assessed for the production region. In addition, the environmental impacts of operating the model systems ae examined. On the basis of estimates found in the literature, capital, operating, and maintenance cost estimates are given for the model systems. The study indicates that the most serious environmental impacts arise from residue removal rather than from conversion.

5487 (COO—2991-34) **Fuel gas production from animal and agricultural residues and biomass.** Wise, D.L.; Wentworth, R.L. (Dynatech R/D Co., Cambridge, MA (USA)). 30 May 1978. Contract EY-76-C-02-2991. 214p. Dep. NTIS, PC A10/MF A01.

Progress was reported by all contractors. Topics presented include: solid waste to methane gas; pipeline fuel gas from an environmental cattle feed lot; heat treatment of organics for increasing anaerobic biodegradability; promoting faster anaerobic digestion; permselective membrane control of algae and wood digesters for increased production and chemicals recovery; anaerobic fermentation of agricultural residues; pilot plant demonstration of an anaerobic, fixed-film bioreactor for wastewater treatment; enhancement of methane production in the anaerobic diegestion of sewage; evaluation of agitation concepts for biogasification of sewage sludge; operation of a 50,000 gallon anaerobic digester; biological conversion of biomass to methane; dirt feedlot residue experiments; anaerobic fermentation of livestock and crop residues; current research on methanogenesis in Europe; and summary of EPA programs in digestion technology. (DC)

5488 (COO—2991-44) **Evaluation of systems for purification of fuel gas from anaerobic digestion. Engineering report.** Ashare, E.;

Augenstein, D.C.; Yeung, J.C.; Hossan, R.J.; Duret, G.L. (Dynatech R/D Co., Cambridge, MA (USA)). 30 Jul 1978. Contract EY-76-C-02-2991. 256p. Dep. NTIS, PC A12/MF A01.

Fuel gas obtained from the anaerobic digestion of waste materials usually needs to be treated before being transmitted in existing pipeline systems. The purification scheme involves the removal of carbon dioxide, hydrogen sulfide, and moisture from the digester gas to meet pipeline specifications. Gas treatment systems for the handling of 0.1, 1.0, and 3.0 MM Scfd of raw feed gas and product delivery pressures of 125 and 1000 psia were considered in this study. From the results of an economic and technical analysis of these systems, physical absorption systems, particularly water scrubbing, were found to be the most economical system for the treatment of digester gas with the flow streams considered. The Fluor Solvent process was economically comparable with the water scrubbing process for high pressure applications, but the value presented had a large uncertainty. The commercial chemical absorption systems were less economical due to high heat requirements for solvent regeneration. Among the chemical absorption processes, the hot potassium systems were found to be more economical than the amine system. The molecular sieve adsorption process was economically similar to the chemical absorption process. The GE membrane separation process was economically comparable for both high and low pressure apllications, but this system has not been evaluated in real-life conditions. Since no kinetic and equilibrium data were available for the phosphate buffer system, estimates had to be assumed. Using what were believed to be very conservative estimates, this chemical absorption process was found to be economically competitive with the water scrubbing process for treating gas with a delivery pressure of 125 psia.The cost analyses in this study were based on the assumption of no recovery of the CO_2 by-product. It was found that credits for the recovery of the CO_2 could be significant.

5489 (COO—4546-8) **Methane production by anaerobic digestion of biomass. Final report of innovative research program subtask, December 1977—September 1978.** Murphy, V.G. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Oct 1978. Contract EG-77-S-02-4546. 29p. Dep. NTIS, PC A03/MF A01.

It has long been known that methane is produced during the anaerobic digestion of agricultural wastes, but this potential source of fuel has not been greatly exploited in the United States. The chief reason is that anaerobic decomposition of lignocellulosic materials occurs very slowly, resulting in a need for long detention times and large digestion vessels, both of which markedly increase process costs. However, recent work at CSU has shown that pretreatment of manure fibers (an abundant agricultural waste) with saturated steam at 130 to 210°C renders this material more susceptible to attack by microbial enzymes. The main objectives of this project were to identify the chemical events occurring during the steam treatment and to correlate these with the rate of methane generating during subsequent anaerobic digestion. The study was expected to lead to an optimal pretreatment strategy.

5490 (LBL—9190) **Pretreatment of biomass prior to liquefaction.** Schaleger, L.L.; Yaghoubzadeh, N.; Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 5p. (CONF-790638—6). Dep. NTIS, PC A02/MF A01.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

Pretreatment of biomass prior to liquefaction was proposed by the Bureau of Mines as an optional procedure for injecting biomass into high pressure vessels. In the Bureau of Mines process the purpose of pretreatment was to change the rheological properties of biomass so that biomass flour/oil slurries containing up to 50 percent treated biomass could be injected into high pressure vessels. Lawrence Berkeley Laboratory researchers investigated the rheological and chemical changes occurring upon pretreatment of wood and conceptualized a process scheme in which wood chips are hydrolyzed under mild conditions to obtain a concentrated aqueous slurry that can be directly injected into the liquefaction system without a carrier oil. This presentation deals with the results of the LBL studies on pretreatment of biomass prior to liquefaction and the process conceptualized at LBL.

5491 (LBL—9191) **Potential for biomass liquefaction.** Seth, M.; Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 9p. (CONF-790638—7). Dep. NTIS, PC A02/MF A01.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

A first, broad, overview of biomass liquefaction is presented. Four desirable chemical conversion routes that may be useful in the liquefaction of wood have been identified. Process conceptualization has been attempted based on an analysis of changes in physical structure, elemental composition and chemical transformation that may occur during liquefaction. Possible process streams have been characterized and likely separation procedures identified.

5492 (SERI/TR—33-239(Vol.1)) **Survey of biomass gasification. Volume I. Synopsis and executive summary.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1979. Contract EG-77-C-01-4042. 45p. Dep. NTIS, PC A03/MF A01.

Biomass can be converted by gasification into a clean-burning gaseous fuel that can be used to retrofit existing gas/oil boilers, to power engines, to generate electricity, and as a base for synthesis of methanol, gasoline, ammonia, or methane. This survey describes biomass gasification, associated technologies and issues in three volumes. Volume I contains the synopsis and executive summary, giving highlights of the findings of the other volumes. In Volume II, the technical background necessary for understanding the science, engineering, and commercialization of biomass is presented. In Volume III, the present status of gasification processes is described in detail, followed by chapters on economics, gas conditioning, fuel synthesis, the institutional role to be played by the federal government, and recommendations for future research and development.

5493 (ANL-Trans—1164) **Production of methane using an anaerobic filter.** Pedersen, K.B. (Puerto Rico Univ., Mayaguez). Apr 1979. Translation source information not available. 20p. Dep. NTIS, PC A02/MF A01.

The treatment of waste products using an anaerobic process results in methane gas as a by-product and this gas can be used as a source of energy. The systems used a long time ago did not support a mass of microorganisms and as such required a lot of time. As an example, we can cite anaerobic digesters with a retention time which varies from 30 to 60 days. Since the middle of this century, work has been done on a system which mixes the waste products to be treated with a mass of anaerobic microorganisms, which is called an anaerobic filter. The objective of this investigation is to evaluate the viability of producing methane gas - under the conditions which are valid for Puerto Rico - from domestic sewage, using an anaerobic filter.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 5824

5494 (DOE/ERD—0021) **Biomass energy systems: environmental readiness document.** (Department of Energy, Washington, DC (USA)). Sep 1979. 50p. Dep. NTIS, PC A03/MF A01.

A number of environmental and socio-economic impacts were identified. The large land and water requirements for terrestrial biomass energy production might lead to socio-economic conflicts. It might also lead to an increase in potential for air and water erosion of the soil. Severe ecosystem impacts would result from disturbing 100 million acres of marginal farm land and 350 million acres of forest land. Removal of residues could increase nutrient removal and reduce the amount of organic matter returning to the soil and limit future biomass production. Air pollution from the direct combustion of biomass must be considered. The thermochemical conversion processes produce potentially harmful pollutants. The sludge resulting from the anaerobic digestion has a high biochemical oxygen demand and must be disposed or recycled. The synthesis of ethanol with stillage is dependent on the feedstock. The energy costs to purify the ethanol and pollution control costs appear to prevent economical production of ethanol in the near term. (DC)

PREPARATION

CHEMICAL SYNTHESIS

5495 (EPRI-AF—1227) **Coal-to-methanol via new processes under development: an engineering and economic evaluation.** Chia, W.S.; Good, G.E.; Ng, Y.S. (Braun (C.F.) and Co., Alhambra, CA (USA)). Oct 1979. 112p. Dep. NTIS, PC A06/MF A01.

This report presents the results of a screening study evaluating two coal-to-methanol routes via new processes under development. For the purpose of this study, two coals have been investigated in two different plant configurations: (1) Illinois No. 6 bituminous coal in an all methanol scheme, and (2) Wyodak subbituminous coal in a methanol and distillate fuel oil coproduction scheme. The all methanol production scheme, proposed for the Illinois No. 6 coal, incorporates the Texaco coal water slurry gasification process for the production of synthesis gas. In the case of Wyodak coal a noncatalytic liquefaction process was incorporated to first liquefy the coal to produce distillate fuel oil and then gasify the liquefaction residue slurry in the Texaco oil slurry gasification to produce synthesis gas and hydrogen. In both schemes the Liquid Phase Methanol process was used for the synthesis of methanol from cleaned and conditioned synthesis gas. All other processes incorpo-

rated in the plant configurations have been commercially proven in the petrochemical, chemical, or petroleum refinery industry. The conceptual designs for the two grass roots coal conversion complexes each designed to produce approximately 300 billion Btu per day of storable fuels are presented; included are overall block flow diagrams, steam and utility balances, and water management schemes. Cost estimates, economic assessments, and overall thermal efficiencies are provided for each of the two processing schemes considered.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 5486

HYDRO ENERGY

5496 (DOE/ID/01784—1) **Chicopee Hydroelectric Project. Feasibility assessment.** (Raytheon Co., Burlington, MA (USA)). Feb 1979. Contract EW-78-F-07-1784. 87p. Dep. NTIS, PC A05/MF A01.

The results of a feasibility analysis for hydroelectric generating facilities at the Chicopee Falls Dam in Chicopee, Massachusetts are presented. The project has been examined for economic, engineering, and environmental viability. The projected facility controls a 714 square mile drainage area and would utilize 16 feet of gross head developed by the Chicopee Falls Dam and an additional 10 feet of head at the site of a former dam 580 feet downstream. The plant would generate 9,000,000 kWh of electricity annually with an installed capacity of 1600 kW. Project cost is estimated, based upon a preliminary design effort, to be $4,053,750 at 1978 price levels. This yields a capital cost per kilowatt of $2534. It was assumed that this program would be implemented by the award of a fixed price contract to design, construct and turn over to the buyer on a turnkey basis the hydroelectric facility described herein. The site is typical of many in New England. The dam is soundly constructed and there are no factors to indicate that installation of hydropower at the dam would increase flood risk or cause other changes that would place insurance costs in a special category. The city has placed no value upon property or water rights so that the projected costs reflect only improvements to the site. Environmental impacts of the proposed development have been judged to be minor, and negative impacts seem to be balanced by several favorable effects. The feasibility of the Chicopee project has been measured against difficult criteria. The method used to assign a value to power produced by the hydroelectric project is disadvantageous to the project but is to the advantage of CMLP's customers.

RESOURCES AND AVAILABILITY

5497 (DOE/ID/01761—1) **Feasibility study for a low-head hydroelectric installation at Archusa Creek Dam. Final report to the Pat Harrison Waterway District.** Carlson, K.W.; Herring, J.W. Jr. (Mississippi State Univ., Mississippi State (USA). Engineering and Industrial Research Station). 26 Feb 1979. Contract EW-78-F-07-1761. 33p. Dep. NTIS, PC A03/MF A01.

The rising cost, uncertain future supply, and environmental problems associated with energy sources have resulted in serious investigation of energy sources that have not previously been considered economically and technically feasible. One such source involves low-head hydroelectric generation. The Department of Energy has funded several feasibility studies for the installation of hydroelectric generators at existing low-head dams. Such a feasibility study for the Archusa Creek Dam near Quitman, Mississippi, is described. The study indicates that there are no apparent technical dificulties to prevent such a project and that a suitable turbine-generator could be obtained. The study further indicates that the project should be economically feasible for the Pat Harrison Waterway District (owners of the dam and lake) to construct if arrangements could be completed for interconnecting with the local utility and selling the energy to the utility. The utility (Mississippi Power Company) has expressed interest in such an arrangement.

5498 (DOE/ID/01772—1) **Assessment of the feasibility of recommissioning the French Landing Hydroelectric Facility in Van Buren Township, Michigan. Final report.** (Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI (USA)). Feb 1979. Contract EW-78-F-07-1772. 208p. Dep. NTIS, PC A10/MF A01.

The results of a study of the feasibility of recommissioning a small, low-head hydroelectric facility in southeastern Michigan are presented. The study concludes that there are several cost-effective designs for recommissioning the site, based on the use of vertical turbines and the sale of power to nearby industrial markets. In terms of the bulk sale of power to the local electric utility, no cost-effective alternatives were found to exist. A major burden on project cost-effectiveness was found to be the relatively large costs for structural repairs to the dam and powerhouse needed to insure safe operation and on adequate service life. From an engineering standpoint it was found that the items of equipment needed to recommission the site are readily available from both US and foreign manufacturers. A variety of hydraulic turbine designs could be successfully adapted to the existing powerhouse, without extensive new construction. It was determined that the production capacity of the facility had an important influence on the cost-effectiveness of the project. A detailed benefit/cost analysis was conducted to identify the optimum facility size in terms of incremental costs and revenues. A detailed environmental assessment using an impact matrix methodology concluded that the development of the facility for hydroelectric generation would have important positive environmental consequences related to improved impoundment and flow management techniques as well as enhanced public safety due to structural repairs to the dam. The institutional and regulatory implications of developing the site for hydroelectric generation were found to be significant but manageable.

5499 (DOE/ID/01780—1) **Piqua Hydroelectric Project. Feasibility assessment report.** (Beck (R.W.) and Associates, Seattle, WA (USA)). Mar 1979. Contract EW-78-F-07-1780. 89p. Dep. NTIS, PC A05/MF A01.

The feasibility of hydroelectric generation at the existing Piqua Dam site located on the Great Miami River in Ohio was studied. The studies and investigations included site reconnaissance, system loads, growth rate, site hydrology, conceptual project arrangements and layouts, power studies, estimates of construction costs, development of capital costs, economic feasibility, development of a design and construction schedule, and preliminary environmental review of the proposed development. The Piqua Hydroelectric Project would consist of a new installation on the left (east) bank downstream from the existing dam, including a power intake, power conduit, powerhouse, tailrace channel, access road, and transmission line which would interconnect directly to the City's existing distribution system. The Project would pose no unusual technical or environmental problems. The Project would have an installed capacity of 400 kW. Because of the wide variation in streamflows no firm (prime) energy or dependable capacity results from the Project operation. Based on the economic feasibility analysis, the Piqua Hydroelectric Project does not show economic feasibility to the City during the first 10 years of operation and development of the Project cannot be justified. It is therefore recommended that the City abandon further consideration of the Project.

5500 (DOE/ID/01781—1) **Reactivation or expansion of Hotel Baker Hydro plant. Feasibility assessment report.** (Harza Engineering Co., Chicago, IL (USA)). Mar 1979. Contract EW-78-F-07-1781. 164p. Dep. NTIS, PC A08/MF A01.

The Hotel Baker Hydroelectric Power plant, built in 1928 at St. Charles, IL., has two generating units which until 1970 supplied the hotel with 100 kW output at 6 ft. head. The feasibility of reactivating, upgrading, or replacing these units to again supply power for the hotel was evaluated considering installation and operating costs, financing requirements, environmental impacts, and regulatory requirements. It was concluded that the reactivation project is marginally attractive only with full use of the power output by an expanded hotel and if electric utility rates increase at 8% per year. (LCL)

5501 (DOE/ID/01789—1) **Feasibility study for low-head hydropower on the Mill River, Northampton, Massachusetts.** (Curran Associates, Inc., Northampton, MA (USA); Montreal Engineering Co. Ltd., Quebec (Canada)). Jan 1979. Contract EW-78-F-07-1789. 107p. Dep. NTIS, PC A06/MF A01.

Five existing dams along a 6.5-mile reach of the Mill River in the City of Northampton, Massachusetts were studied to assess the feasibility of developing the sites for low-head hydroelectric power generation. Each of the dams was inspected to evaluate existing conditions and necessary work required to rehabilitate the structures. Analyses of hydrology and power potential were carried out and a packaged tube turbine-generator unit was found to be suitable for installation at all sites. Project layouts were developed making maximum use of existing structures and natural and man-made features. Capital and operation and maintenance costs were estimated based on the project layouts and the selected turbine-generator units. Financial analyses were performed using a set of baseline assumptions. Sensitivity tests of alternative assumptions were also prepared, along with analyses of assistance program alternatives. Finally, the legal, environmental, and socio-institutional considerations affecting development of the hydro projects were identified and reviewed. Hydro developments on the Mill River were found to be technically feasible, presenting no extraordinary engineering, environmental, or legal problems. However, none of these projects, either individually or jointly, would be financially feasible without substantial assistance in the form of capital grants.

5502 (DOE/ID/01790—1) **Feasibility of determination of low-head hydroelectric power development at existing sites: North Hartland Dam Project. Feasibility report.** (Vermont Electric Cooperative, Inc., Johnson (USA)). Mar 1979. Contract EW-78-F-07-1790. 182p. Dep. NTIS, PC A09/MF A01.

The feasibility of constructing a low-head hydroelectric power plant at the North Hartland Dam in Vermont was investigated. Evaluation of technical, economic, environmental, safety, and regulatory aspects led to the conclusion that the North Hartland Dam Hydroelectric Project is a technically feasible concept. The proposed project will have a recommended 6000 kW nominally rated capacity at a 52 ft turbine design head and 1680 cfs demand flow. The gross generation expected from the project is 11,980,000 kWh per year. It is estimated that the project will cost $8,997,000 at 1978 price levels, with no allowance for funds during construction. The project will provide peaking power at a levelized cost of about 41 mills per kWh at 1979 price levels, based on 7% cost of money, a 1985 commissioning date, and allowing for funds during construction and cost escalation over a 30 y period. The benefit-cost ratio compared with an equivalent oil-based generation source over a similar period is estimated as 1.06. (LCL)

5503 (DOE/ID/01796—1) **Cataract hydroelectric development expansion study.** (Central Maine Power Co., Augusta (USA)). Jan 1979. Contract EW-78-F-07-1796. 68p. Dep. NTIS, PC A04/MF A01.

The Cataract hydroelectric power plant and dam was constructed in 1937-1938 and has been operated continually since that date. This unit is a vertical shaft Kaplan type machine with a rated output of 6650 kW at a design head of 44 ft. Maximum output is 8000 kW. The feasibility of expanding this existing plant was studied. The results indicate the following: the available head and unused flow at the Cataract Project will support an additional 6250 kW of generating capacity; the estimated gross plant investment cost of this plant would be $5,230,000 at present day costs. If a fishway is required the investment is estimated to be $5,730,000; and based on the analysis of 60 y of historical flow records this capacity addition would generate an average of 15,910,000 kWh annually. This feasibility study indicates that redevelopment of the Cataract site is a marginally economic proposition which might offer some savings, over the life of the unit; however, two significant questions remain unanswered. First, will a fishway be required as part of the redevelopment. Second, can a new or renewed fifty year FERC license be obtained for the Cataract site. (LCL)

5504 (DOE/ID/01797—1) **City of Redding: Lake Redding Power Project, feasibility assessment report.** (CH2M Hill, Redding, CA (USA)). Mar 1979. Contract EW-78-F-07-1797. 59p. Dep. NTIS, PC A04/MF A01.

The feasibility of constructing a low-head hydroelectric power generating facility on the Sacramento River in California was investigated considering technical, economic, legal, and environmental factors. It was concluded that the proposed plant is feasible and, with 5 generating units operating on a gross head of 14 ft, 79 GWh could be generated annually. The cost of the project with a 1984 completion date is estimated at $44.3 million. (LCL)

5505 (DOE/ID/01798—1) **Tuttle Creek Hydroelectric Project feasibility assessment report.** (Beck (R.W.) and Associates, Denver, CO (USA)). Mar 1979. Contract EW-78-F-07-1798. 145p. Dep. NTIS, PC A07/MF A01.

The results are presented of a feasibility assessment study to determine if hydroelectric generation could be developed economically at the Corps of Engineers' Tuttle Creek Dam, an existing flood control structure on the Big Blue River near Manhattan, Kansas. The studies and investigations included site reconnaissance, system load characteristics, site hydrology, conceptual project arrangements and layouts, power studies, estimates of construction costs, development of capital costs, economic feasibility, development of a design and construction schedule and preliminary environmental review of the proposed Project. The dependable capacity of the Project as delivered into the existing transmission and distribution network is 12,290 kW and the average annual energy is 56,690 MWh. For the scheduled on-line date of July 1984, the Project is estimated to have a Total Investment Cost of $19,662,000 (equal to $1333/kW installed at that time frame) with an estimated annual cost for the first year of operation of $2,696,000, assuming REA financing at 9.5% interest rate. The Project is considered technically feasible and without any major environmental issues. It shows economic feasibility providing satisfactory financing terms are available. (LCL)

5506 (DOE/ID/01801—1) **Potential Hydroelectric Power Upriver Dam: City of Spokane Department of Utilities Water Division.** (Spokane City Dept. of Utilities, WA (USA). Water Div.; Tudor Engineering Co., Seattle, WA (USA)). Feb 1979. Contract EW-78-F-07-1801. 112p. Dep. NTIS, PC A06/MF A01.

The technical, economic, environmental and institutional feasibility of increasing the power generation capacity of the City of Spokane's Upriver Dam Complex by installing additional generating facilities and/or modifying existing facilities were studied. It is proposed that the existing powerhouse be uprated from 3.9 to 4.5 MW and that a new powerhouse be constructed with two 4.5 MW turbines to provide an annual additional energy production of 62.3 million kWh. No adverse environmental or safety effects are foreseen, the socio-institutional impacts will be beneficial, there is a market for the power produced, and the benefit/cost ratio is advantageous. (LCL)

5507 (DOE/ID/01803—1) **Feasibility of restoring the Greggs Falls site to active service as a low-head hydroelectric facility.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 16 Aug 1979. Contract EW-78-F-07-1803. 209p. Dep. NTIS, PC A10/MF A01.

A study was conducted to determine the feasibility of restoring to service the deactivated Greggs Falls hydroelectric station in Goffstown, New Hampshire. Evaluation of technical, economic, legal, institutional, and environmental factors led to the conclusion that restoration was both feasible and attractive. The site can be restored for an investment of $2.1 to $2.4 million (depending on the operational mode) to establish 1.5 MW of capacity and produce 7945 MWh of electrical energy annually. Within 3 years, operation of the site can produce energy at lower costs than the cost of fuel oil in New England and will save approximately 14,600 barrels of fuel oil annually. The economic competitiveness of the facility is expected to improve with time because of the rising price of imported oil.

5508 (DOE/ID/01811—1) **Dry Falls Dam potential hydroelectric power. Feasibility study.** (Tudor Engineering Co., Seattle, WA (USA)). Jan 1979. Contract EW-78-F-07-1811. 129p. Dep. NTIS, PC A07/MF A01.

The feasibility of constructing a low-head hydroelectric power plant at the existing Dry Falls Dam in Washington was studied considering technical, economic, environmental, regulatory, and safety factors. As a result of this study it is recommended that a 12 MW power plant be installed. Annual energy production would be 56 million kWh at an initial cost of 21.2 mills/kWh. (LCL)

5509 (DOE/ID/01816—1) **Feasibility study of upgrading Byllesby and Buck power plants on the New River in the Commonwealth of Virginia.** (American Electric Power Service Corp., New York). May 1979. Contract EW-78-F-07-1816. 180p. Dep. NTIS, PC A09/MF A01.

The feasibility of upgrading alternatives of the 66-year-old Byllesby and Buck hydroelectric developments located on the New River in Virginia was investigated. Evaluation of technical, economic and environmental factors led to the conclusion that modernization of the plants could result in an annual generation increase of 20.2 GWh at a cost of $6.1 million and with a benefit-cost ratio of 2.32. The recommended retrofitting includes replacing existing runners with new, more efficiently designed runners, modifying draft tube and wicker gate, and rewinding the generators. (LCL)

5510 (DOE/ID/01817—2) **Feasibility determination for hydroelectric development at Thermalito Afterbay with STRAFLO turbine-generators. Final report.** Mueller, B.L. (Aerojet Mfg. Co., Fullerton, CA (USA)). Jun 1979. Contract EW-78-F-07-1817. 171p. Dep. NTIS, PC A08/MF A01.

This study addresses the development of the Thermalito Afterbay, in California. Presently, the outlet of the afterbay dissipates the afterbay's useful energy through five radial gates into the Feather River complex. The feasibility of constructing a hydroelectric facility to recover this wasted energy through the use of STRAFLO hydro turbines is appraised, and data relevant to the future economic benefits of such a facility as compared to alternate energy alternatives are presented. In addition, the regulatory, ecological, and socio-institutional impacts which form additional considerations to a future thermalito afterbay site development are summarized. The study shows an annual generation potential of 48.82 GWh. The cost of developing the site is estimated to be $23.5 million. Social and environmental effects would be minimal. The final feasibility of development is contingent on power contracts which the state of California will be negotiating in 1983. (LCL)

5511 (DOE/ID/01822—1) **Potential hydroelectric power. Vertical turbine: spillway combine Broadwater Dam. Final report.** Willer, D.C. (Tudor Engineering Co., San Francisco, CA (USA)). 23 Apr 1979. Contract EW-78-F-07-1822. 237p. Dep. NTIS, PC A11/MF A01.

A feasibility study was made of the hydroelectric power potential at Broadwater Dam in western Montana. Two alternative configurations for the potential project were evaluated and the economics of four possible sources of project funding were assessed. The configurations analyzed were an apron-mounted configuration, in which the turbine-generator units are located on the downstream apron of the existing dam, and a conventional configuration, in which the units are located in a new powerhouse adjacent to the existing dam. The funding sources considered were the Department of Energy loan program, the United States Bureau of Reclamation PL-984 loan program and conventional revenue bonds, both taxable

and tax-exempt. The optimal project alternative was determined to be the apron-mounted configuration. The final choice of funding would be dependent on the power purchaser. It was shown that, regardless of the configuraton or funding source selected, the project would be feasible. The cost of the apron-mounted configuration, which would consist of four turbine-generator units for a total installed capacity of 9.76 MW, was estimated as $13,250,000 with financing provided by either a PL-984 loan or tax-exempt bonds. The cost per installed kilowatt was therefore $1,350, and the cost per kilowatt-hour was 19.6 mills. The average annual energy was estimated to be 56.44 million kWh, the equivalent of approximately 87,000 barrels of oil per y. It is therefore recommended that the Montana Department of Natural Resources and Conservation proceed with the project and that discussions be initiated with potential power purchasers as soon as possible.

SOLAR ENERGY

REFER ALSO TO CITATION(S) 5855

5512 (PB—289762) **Application of solar technology to today's energy needs. Volume 2.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1978. 763p. NTIS PC A99/MF A01.

Volume 1 (PB-283 770) of this report reviews a range of solar energy systems designed to produce thermal and electrical energy directly from sunlight with units small enough to be located on or near the buildings they are designed to serve. It examines the state-of-the-art technology, identifies the circumstances under which such systems could be economically attractive, and discusses the problems encountered in integrating these devices into existing energy generation and delivery systems. The study also assesses the impact that widespread use of decentralized solar energy equipment could have on the United States -- its energy supplies, its ability to achieve foreign policy objectives, its physical environment, its levels and patterns of employment, and the functioning of the society as a whole. Volume II specificially deals with backup requirements, systems analysis, and costs.

5513 (PB—290376) **Swedish solar energy projects 1978.** Bergqvist, B.; Holmberg, J.G. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). 1978. 160p. NTIS PC A08/MF A01.

This report presents 99 separate solar energy projects divided into: 37 projects on buildings with solar heating systems; 9 projects on open air bathes with solar heating systems; 6 projects on solar heating systems with seasonal storage; 7 research projects on the prerequisites for solar heating in Sweden; 33 research projects on the prerequisites for systems, methods and components; and, 7 solar electricity projects.

RESOURCES AND AVAILABILITY

5514 (PB—292712) **Solar energy information and data for illinois.** Changnon, S.A. Jr. (Illinois State Water Survey, Urbana (USA)). 1978. 67p. NTIS, PC AA04/MF A01.

This report is essentially a solar data compendium for Illinois. It contains a minimum of text and consists mainly of tables and graphs, largely assembled from a wide variety of publications (many not easily found). The information presented is largely based on averages for various records and periods (daily, weekly, monthly, and annually). Some extremes are presented where available. Also, where available, various probabilities of events (such as runs of days with sunshine or radiation) are given. Average monthly values of temperatures (and extremes of temperature), relative humidity, and winds are offered for various state locales. Various weather conditions that will create problems for solar collectors are reviewed. Included are average and extreme values of hail, thunderstorms, pollution, snow, and ice, all presented to reveal the dimensions of these hazards.

ECONOMICS

REFER ALSO TO CITATION(S) 5875

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 5494, 5870, 5871, 5872, 5873, 5874, 6171, 6172, 6184

5515 (LA—7995-TASE) **Characterization and assessment of selected solar thermal energy systems for residential and process heat applications.** Hyde, J.C. (Los Alamos Scientific Lab., NM (USA)). Aug 1979. Contract W-7405-ENG-36. 55p. Dep. NTIS, PC A04/MF A01.

The environmental data presented are in partial response to the Technology Assessment of Solar Energy (TASE) program. TASE is an assessment of the potential environmental, socioeconomic, and institutional impacts of solar technologies on the national, regional, and local community levels. The results of studies of seven solar thermal energy applications are presented. Five of these are residential applications: space heating - active liquid, space heating - active air, domestic hot water - active, space heating - passive, and space heating and cooling - active liquid. Denver, Colorado, was selected as a representative location for each of the above applications. The remaining two applications produce industrial process heat: a flat-plate collector system producing 50°C to 100°C hot water for a commercial laundry in Indianapolis, Indiana; and a concentrating collector system that could produce 100°C to 300°C process heat adequate to the needs of a pulp mill in Madison, Wisconsin. For each application, a representtive system model and preliminary designs of major system elements were established. Then the following data were generated: annual useful energy produced, type and weight of the basic component materials, environmental residuals generated during system operation, and land and water requirements. These data were generalized for other TASE study purposes by expressing them as quantities per 10^{15} Btu of useful energy. This report discusses the system characteristics and evaluates the environmental impacts. To allow the reader to estimate system performance at other geographic locations than those studied, insolation and other pertinent data are provided.

5516 (NP—24048) **Solar tax credit regulations. Interim committee report.** (California Energy Commission, Sacramento (USA)). 1979. 17p. California Energy Commission, 1111 Howe Avenue, Sacramento, CA 95825.

On September 25, 1978, Governor Brown signed into law AB 3623, a modification to existing statutes which allow California taxpayers to credit up to 55 percent of the cost of a solar energy system against their State income tax obligations (Revenue and Taxation Code, Sections 17052.5 and 23601). On October 25, 1978, the Energy Commission adopted an Order Instituting Hearings to conform the Commission's regulations (Title 20, Chapter 2, Subchapter 8, Article 1) to the statutory changes resulting from AB 3623. The order provided for consideration of the definition of solar energy system, adoption of eligibility criteria for wind and solar electric systems, and other technical or clarifying changes. A set of proposed new regulations, together with a staff report in support of the suggested changes, was made available to the public on December 29, 1978. Hearings on the proposed revisions to the regulations were held on January 15 and January 16, 1979, in San Francisco and Los Angeles respectively. This interim Committee Report summarizes the arguments on the proposed regulations and the Committee's conclusions to date.

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 5806, 5875

PHOTOVOLTAIC CONVERSION

5517 (AD-A—064431) **Nonreflecting vertical junction silicon solar cell optimization. Final report 15 May 1976-31 August 1978.** Wohlgemuth, J.H.; Wrigley, C.Y. (Solarex Corp., Rockville, MD (USA)). Nov 1978. Contract F33615-76-C-2058. 71p. NTIS, PC AA04/MF A01.

This research program has resulted in the development of high conversion efficiency radiation resistant vertical junction silicon solar cells. New techniques of oxidation growth and the use of photolithography enable the use of an orientation dependent etch to produce grooves 5 - 10 micrometers wide and up to 100 micrometers deep. These silicon wafers have been processed into solar cells with all processes performed at temperatures compatible with producing high efficiency solar cells. Theoretical calculations of the expected current as a function of radiation dose have been performed. An explanation of the observed open-circuit voltage is provided. Vertical junction solar cells have been fabricated with AM0 conversion efficiencies greater than 14%. These cells have shown superior radiation resistance. Vertical junction cells have been fabricated in 2cm x 2cm, 2cm x 4cm and 2cm x 6cm sizes with no size dependence on efficiency or yield. (Author)

5518 (COO—4094-58) **Regional differences in energy costs: their persistence and implications for solar photovoltaics.** Katzman, M.T. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 28 Sep 1979. Contract EY-76-C-02-4094. 21p. Dep. NTIS, PC A02/MF A01.

The economic benefits of solar photovoltaics are measured by the savings in conventional energy costs. Where the conventional energy source is the central electric grid, interregional differences in electric rates must be taken into account. This study considers the persistence, future course, and magnitude of these interregional differences. The main conclusion is that differences of 20% around the mean will persist; the Northeast will remain on the high end, the Tennessee Valley and the Pacific Northwest on the low end. Even though the magnitude of insolation in the Northeast is relatively low, the high cost of electricity brings the benefits of solar photovoltaics in this region up to the national average.

5519 (COO—4094-59) **Influencing the operating temperatures of Motorola and Arco Solar photovoltaic modules.** Raghuraman, P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 11 Oct 1979. Contract EY-76-C-02-4094. 30p. Dep. NTIS, PC A03/MF A01.

The electrical power output of photovoltaic solar cell modules decreases with increasing cell temperatures. Two such efforts on Motorola and Arco Solar modules are detailed using test measurements and anaysis to increase the heat transfer from the modules and thereby lower the cell operating temperatures. The radiant heat emitted by the rear stainless steel pan of Motorola modules was increased by painting the pan with black and with white paint. This produced a pan temperature cooling of 3.5°C to 5°C, resulting in an increased electrical power output of 1.7 to 1.95%. Arco Solar modules were oriented horizontally and vertically to compare the effect of natural with forced convection cooling in the interior air column of the module. Natural convective heat transfer by vertical orientation produced a 1 to 3.5°C cooling over forced convective cooling by horizontal orientation. This cooling resulted in an increased cell electrical power output of 1 to 2.5%. A simple one-dimensional heat-transfer model, which was analyzed for each of the modules, yielded results consistent with test measuremets.

5520 (COO—23001-1) **Development of high efficiency, low cose $ZnSiAs_2$ solar cells RTI Project 41U-1803. Quarterly technical progress report No. 1, April 9-June 30, 1979.** Andrews, J.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). 1979. Contract AC04-79ET23001. 6p. Dep. NTIS, PC A02/MF A01.

An investigation of one of the chalcopyrite semiconductors ($ZnSiAs_2$) in order to assess its suitability as a solar cell material is described. In work previously performed, $ZnSiAs_2$ had been synthesized using an open tube vapor phase epitaxial growth technique. Epitaxial layers of $ZnSiAs_2$ had been deposited on Ge and GaAs substrates (both (001) and (112) $ZnSiAs_2$ on (100) and (111) substrates, respectively). Epitaxial deposits were routinely achieved while the surface appearance varied from mirror-like to a dull appearance which resulted from a relatively rough surface topography. Mirror-like finishes were clearly an achievable goal but required additional refinements in growth technique and substrate preparation before they could be routinely achieved. At this time three critical goals have been identified that must be achieved before $ZnSiAs_2$ can be realistically assessed. (1) hole concentrations must be reduced from the current 10^{18} to $10^{19}/cm^3$ range to the 10^{16} to $10^{17}/cm^3$ range; (2) n-type $ZnSiAs_2$ must be demonstrated; (3) $ZnSiAs_2$ p-n junctions must be demonstrated. The approach taken and the progress made toward achieving these goals are discussed as well as the planned effort for the next quarter. (WHK)

5521 (DOE/ET/23038—1) **Black a-Si:H sputtered films for photovoltaic solar cells. Quarterly technical progress report No. 1, May 15, 1979—August 15, 1979.** Messier, R.; Tsong, I.S.T. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). 1979. Contract AC03-79ET23038. 24p. Dep. NTIS, PC A02/MF A01.

Hydrogenated a-Si solar cells were prepared by rf-sputtering. It was found that for a-Si the surface microstructure of sputtered films can be altered by a simple post-deposition etching process and controlled by varying the film preparation conditions. It was demonstrted that such textured surfaces can be advantageous in increasing the efficiency of Schottky-barrier type MS and MIS solar cell structures by decreasing visible reflectance from ~ 45% to less than 2%. The overall objective in this study is to develop the basic and applied understanding of film preparation and characterization, etching behavior, and solar cell device fabrication and measurements; such interrelated studies being necessary for assessing the potential of these textured surfaces. Results are presented and discussed. A preprint of a paper describing the microstructure zone model is appended on black a-Si solar selective absorber surfaces. (WHK)

5522 (DOE/ET/23048—1) **Low cost thin film polycrystalline silicon solar cells. Quarterly project report No. 1, March 15, 1979—June 30, 1979.** Crownover, J.D.; van der Leeden, G.A. (Poly Solar, Inc., Garland, TX (USA)). Jul 1979. Contract AC03-79ET23048. 20p. Dep. NTIS, PC A02/MF A01.

The objective of this research is to advance the thin film silicon solar cell technology developed at Southern Methodist University, Dallas, Texas, with a view toward achieving photovoltaic conversion efficiencies greater than 10% at a cost of $100 to $300/kWe. The technology developed at SMU consists of: (1) the purification of metallurgical silicon by acid extraction and phosphorus pentoxide treatment, (2) the preparation of metallurgical silicon substrates by the unidirectional solidification of the melt on graphite, (3) the deposition of a silicon p-n junction structure on metallurgical silicon substrates by the thermal reduction of trichlorosilane, and (4) the application of grid contacts and anti-reflection coatings. Major efforts during this period have been directed to the organization and planning of the overall technical approaches, particularly in regard to the preparation of metallurgical silicon substrates. The zone-melting technique has been selected for the preparation of substrates, and a moving-coil zone-melting apparatus has been designed and constructed. A chemical vapor deposition apparatus for the deposition of the active region of solar cell has also been designed and constructed. In addition, the purification of metallurgical silicon by acid-extraction has been investigated semi-quantitatively.

5523 (DOE/JPL/1012—33) **Silicon materials outlook study for 1980-85 calendar years.** Costogue, E.; Ferber, R.; Hasbach, W.; Pellin, R.; Yaws, C. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Nov 1979. Contract EX-76-A-29-1012. 72p. Dep. NTIS, PC A04/MF A01.

Photovoltaic solar cell arrays converting solar energy into electrical energy can become a cost-effective, alternative energy source provided that an adequate supply of low-priced solar cell materials and automated fabrication techniques are available. Presently, the photovoltaic industry is dependent upon polycrystalline silicon which is produced primarily for the discrete semiconductor device industry. This dependency is expected to continue until DOE-sponsored new technology developments mature. Recent industry forecasts have predicted a limited supply of polycrystalline silicon material and a shortage could occur in the early 80's. The Jet Propulsion Laboratory's Technology Development and Application Lead Center formed an ad hoc committee at JPL, SERI and consultant personnel to conduct interviews with key polycrystalline manufacturers and a large cross-section of single crystal ingot growers and wafer manufacturers. Industry consensus and conclusions reached from the analysis of the data obtained by the committee are reported. The highlight of the study is that there is a high probability of polycrystalline silicon shortage by the end of CY 1982 and a strong seller's market after CY 1981 which will foster price competition for available silicon.

5524 (DOE/JPL/954796—5) **Analysis and evaluation of processes and equipment in Tasks II and IV of the Low-Cost Solar Array Project. Quarterly report, August-October 1978.** Wolf, M. (Pennsylvania Univ., Philadelphia (USA). Moore School of Electrical Engineering). Jan 1979. Contract NAS-7-100-954796. 46p. Dep. NTIS, PC A03/MF A01.

The manufacturing methods for photovoltaic solar energy utilization systems consist, in complete generality, of a sequence of individual processes. This process sequence has been logically segmented into five major work areas: reduction and purification of the semiconductor material, sheet or film generation, device generation, module assembly and encapsulation, and system completion, including installation of the array and the other subsystems. For silicon solar arrays, each work area has been divided into 10 generalized processes in which certain required modifications of the work-in-process are performed. In general, more than one method is known by which such modifications can be carried out. The various methods for each individual process are identified as process options. In the search to achieve improved process sequences for producing silicon solar cell modules, numerous options have been proposed and/or developed, and will still be proposed and developed in the future. It is a near necessity to be able to evaluate such proposals for their technical merits relative to other known approaches, for their economic benefits, and for other techno-economic attributes such as energy consumption, generation and disposal of waste by-products, etc. A methodology for the objective comparative evaluation of competing subsystem design or manufacturing process options is described. The evaluation criterion is the cost of the energy delivered from the system. A requirement for the analysis is, that the subsystems or process options to be evaluated are functionally comparable. The evaluations are based on differences in cost and performance (efficiency) for the subsystem designs, and on differences in cost, efficiency contribution, and yield for manufacturing process options. (WHK)

5525 (DOE/JPL/954868—4) **Automated Array Assembly, Phase II. Quarterly report No. 4.** D'Aiello, R.V. (RCA Labs., Princeton, NJ (USA)). Oct 1978. Contract NAS-7-100-954868. 40p. Dep. NTIS, PC A03/MF A01.

The purpose of the overall program is to establish technological readiness and provide verification for the elements of a manufacturing sequence which would ultimately be suitable for the large-scale production of silicon solar-array modules at a selling price of less than $500/kW. A program and process plan for accomplishing

this objective was developed and put into operation during the first quarter. The processing sequence is described. Three junction-formation processes are under consideration; since our cost analysis shows that they do not differ greatly in cost, each should be considered for technical merits and possible future cost reduction. The progress made in the various process steps of the plan is described, and conclusions are presented. (WHK)

5526 **High output solar cells .** Milnes, A.G. US Patent 4,158,577. 19 Jun 1979. Filed date 5 Jul 1978. 8p.

A high output solar cell comprises a three-layer semi-conductor compound article, the layers being doped in pn_1n_2 order in the direction of light travel, the pn_1 junction being a homojunction and the n_1n_2 junction being a heterojunction. The doping of the layers is such that valley-transferred or hot electrons, so-called, are created in the p and n region secondary electron conduction bands and are transferred to the normal conduction band edge of the n_2 heterojunction material and ultimately to an ohmic contact.

5527 **Solar cells.** Ravi, K.V. (to Mobil Tyco Solar Energy Corp.). US Patent 4,152,536. 1 May 1979. Filed date 2 Dec 1977. 8p.

Disclosed are solar cells employing slightly curved or nearly flat monocrystalline silicon ribbons. The ribbons are formed by cutting or slicing monocrystalline hollow tubes along their lengths, the tubes having been formed according to crystal growing processes disclosed in US Pat No 3,591,348. 3 claims.

5528 **Solar cell arrangement for terrestrial use.** Gochermann, H. (to Licentia Patent-Verwaltungs-GmbH). US Patent 4,147,560. 3 Apr 1979. Priority date 5 Mar 1977, German, Federal Republic of (F.R. Germany), 4p.

A solar cell generator is described for producing electrical energy for terrestrial use including a plurality of interconnected solar cells encased on all sides by a radiation resistant plastic material and a foil of a weather resistant material which adheres to the plastic material covering the outer surfaces of the casing.

THERMIONIC AND THERMOELECTRIC CONVERSION

5529 (SERI/TR—35-078(Vol.1)) **Conversion system overview assessment. Volume 1: solar thermoelectrics.** Jayadev, T.S.; Henderson, J.; Finegold, J.; Benson, D. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1979. Contract EG-77-C-01-4042. 214p. Dep. NTIS, PC A10/MF A01.

An assessment of thermoelectrics for solar energy conversion is given. There is significant potential for solar thermoelectrics in solar technologies where collector costs are low; e.g., Ocean Thermal Energy Conversion (OTEC) and solar ponds. Reports of two studies by manufacturers assessing the cost of thermoelectric generators in large scale production are included in the appendix and several new concepts thermoelectric systems are presented. (WHK)

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 5292, 5486, 5487, 5488, 5489, 5490, 5491, 5492, 5493, 5494, 5643, 6187, 6214

PHOTOVOLTAIC POWER PLANTS

5530 (DOE/NASA/20370—79/19) **Photovoltaic power system reliability considerations.** Lalli, V.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EX-76-A-29-1004. 10p. (NASA-TM—79291). Dep. NTIS, PC A02/MF A01.

An example of how modern engineering and safety techniques can be used to assure the reliable and safe operation of photovoltaic power systems is described. This particular application was for a solar cell power system demonstration project in Tangaye, Upper Volta, Africa, one of two photovoltaic village power projects currently managed by the Photovoltaic Project Office. The techniques involve a definition of the power system natural and operating environment, use of design criteria and analysis techniques, an awareness of potential problems via the inherent reliability and FMEA methods, and use of a fail-safe and planned spare parts engineering philosophy. The Tangaye system has been operating since March 1, 1979. This is the second photovoltaic system designed to provide electric power requirements for remote villages. The first village power system was installed at Schuchuli, Arizona in December 1978.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 5529

5531 (SAND—79-8222) **Credibility of cost estimates for mass-produced heliostats.** Eason, E.D. (Sandia Labs., Livermore, CA (USA)). Oct 1979. Contract EY-76-C-04-0789. 25p. Dep. NTIS, PC A02/MF A01.

Five analysis approaches are applied to the McDonnell Douglas second generation prototype heliostat capital cost estimates in an attempt either to justify or to discredit them. The estimates are not discredited by any of these approaches, so they are accepted as credible. A range of credible costs is calculated based on the analyses. This range is $\$100/m^2/R$ to $\$60/m^2/R$ for unit number 350,000 at 25,000/y production rate.

CENTRAL RECEIVER

5532 (PNL-SA—8015) **Development of mirror specifications.** Lind, M.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. 12p. Dep. NTIS, PC A02/MF A01.

The work performed by PNL for Sandia Laboratories under a contract titled Survey and Analysis of Mirror Silvering Technology and Heliostat Glass Evaluation is described. The primary purpose for the work was to develop specifications that will enhance the durability and lifetime of heliostat mirrors. The contract was initiated with a technical survey of the present commercial silvered glass mirror industry and an analytical investigation of the degradation phenomena experienced by the heliostat mirrors at Sandia's Livermore test facility. The main thrust was to evaluate the present methods of silver deposition and protection in order to recommend a specification for the heliostat mirror silvering process that would extend the lifetime of the Barstow mirror field. In addition, several advanced concepts for enhancing mirror lifetime were investigated. Technical and measurement support for evaluation of the Barstow heliostat glass and updating the glass specification was also provided. (WHK)

5533 (SAND—78-8228) **Optical studies of second surface mirrors proposed for use in solar heliostats.** Vitco, J. Jr. (Sandia Labs., Livermore, CA (USA)). Apr 1978. Contract EY-76-C-04-0789. 33p. Dep. NTIS, PC A03/MF A01.

Initial studies centered on characterization of iron-associated absorptive losses in the glass substrate, the reflectivity of the silver-glass interface, and the presence or absence of environmental aging (weathering and solarization) in glasses subject to prolonged (30 to 50 years) outdoor exposures are reported. These studies conclude that: (1) the effective solar-weighted absorption coefficient of Fe^{2+} is approximately 15 times larger than that of Fe^{3+}; (2) although Corning 0317 fusion glass has one of the highest iron contents, it also has the highest transmissivity of any glass studied because all the iron is present as Fe^{3+}; (3) measured reflectivities of the silver-glass interface for chemically deposited silver ranged from 96.2 to 97.5%, while that of a vapor deposited silver mirror was 97.6%; and (4) the transmissivity of glasses subject to prolonged outdoor exposure was degraded at short wavelengths and improved at long wavelengths, resulting in a maximum observed loss in solar transmissivity of 3.4%.

DISTRIBUTED COLLECTOR

5534 (COO—2771-1) **Solar thermal electric power systems with line-focus collectors. Final report.** Duff, W.S.; Karaki, S.; Shaner, W.W.; Wilbur, P.J.; Somers, E.V.; Grimble, R.E.; Wilson, H.S.; Watt, A.D. (Colorado State Univ., Fort Collins (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA); Watt Engineering Ltd., Cedaredge, CO (USA)). Dec 1978. Contract EY-76-S-02-2771. 281p. Dep. NTIS, PC A13/MF A01.

Electric power generation by conventional Rankine cycle heat engines with heat supplied by line-focus solar collectors was investigated. The objectives of the study were: (1) determine which of four types of line-focus solar collectors coupled with turbine-generators of conventional design has the potential to produce low-cost electric power with thermal energy in 100 to 300°C range; (2) develop performance and cost relationships for organic Rankine cycle engines for power generation capacities from 3 MW/sub e/ to 300 MW/sub e/; (3) develop conceptual storage units for organic fluid systems. Evaluation procedures and study results and conclusion are presented and discussed in detail. (WHK)

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 5529

5535 (AD-A—064787) **Two-dimensional numerical model of the near-field flow for an Ocean Thermal Power Plant. Part I. The theoretical approach and a laboratory simulation.** Roberts, G.O.; Piacsek, S.A.; Toomre, J. (Science Applications, Inc., McLean, VA (USA)). 1977. Contracts N00014-76-C-0610;E(49-26)-1005. 53p. NTIS, PC AA04/MF A01.

This report describes the computer model NRFL02 which has been developed to calculate the near-field stratified turbulent flow driven by the intakes and outflows of an ocean thermal power plant. A two-dimensional geometry is assumed, with the power plant intakes and jet outflows modelled by boundary conditions on the left boundary of a rectangular domain. Horizontal flow through the right boundary, to or from the far-field, is allowed by assuming a pressure in hydrostatic equilibrium with the ambient density distribution. The code uses a first-order closure model to treat the stratified turbulence. Advanced numerical methods enable convergent and accurate solutions to be obtained rapidly and economically. A simple laboratory simulation of two-dimensional stratified turbulence driven by intakes and jet outflows is proposed in order to address the general question of near-flow recirculation. Numerical results from NRFL02 are presented for the proposed experimental simulation. They confirm our analysis predicting a stability limit on the far-field horizontal flow, and demonstrate the occurrence of recirculation for fast flow cases.

5536 (AD-A—064788) **Two-dimensional numerical model of the near-field flow for an Ocean Thermal Power Plant. Part III. Manual for the computer code NRFl02.** Roberts, G.O.; Piacsek, S.A.; Toomre, J. (Science Applications, Inc., McLean, VA (USA)). 1977. Contracts N00014-76-C-0610;E(49-26)-1005. 54p. NTIS, PC AA04/MF A01.

This report is a user's manual for computer code NRFL02 which has been developed to calculate the near-field stratified turbulent flow driven by the intakes and outflows of an ocean thermal power plant. The code uses a two-dimensional geometry and a four-parameter first-order turbulence closure model. Sophisticated numerical methods enable convergent and accurate solutions to be obtained rapidly and economically. A large and flexible printer output package provides for the display and interpretation of the results.

5537 (AD-A—064789) **Recirculation and thermocline perturbations from Ocean Thermal Power Plants.** Piacsek, S.A.; Martin, P.J.; Toomre, J.; Roberts, G.O. (Science Applications, Inc., McLean, VA (USA)). 1977. Contracts N00014-76-C-0610;E(49-26)-1005. 26p. NTIS, PC AA03/MF A01.

Numerical experiments were performed on the fluid motions resulting from the pumping action of ocean thermal power plants. In particular, the resulting thermocline distortions, sea surface temperature decrease and corresponding heat flow change were investigated. The object was to find engine discharge configurations and pumping rates that would minimize these alterations. This would result in both a minimal environmental impact and preservation of the temperature gradient across the engine, i.e. the energy resource. The results obtained to date use 2-D turbulent flow calculations. Near the engine, the sea surface temperature reduction ranges from 0.01 F to 3 F, depending on design, flow rate, season and location. The mean temperature of the warm inflow water is reduced by up to 4 F from the mean temperature at that depth, for certain designs and flow rates, due to recirculation and turbulence.

5538 (AD-A—064790) **The effect of Ocean Thermal Power Plants on the thermodynamic characteristics of the marine atmosphere: some preliminary results from a one-dimensional model.** Clancy, R.M. (Science Applications, Inc., McLean, VA (USA)). 20 Sep 1977. Contract N00014-76-C-0610. 31p. NTIS, PC AA03/MF A01.

A one-dimensional model consisting of conservation equations for momentum, moisture, and thermodynamic energy in the cloud-free marine atmosphere is constructed and used to investigate the effect of sea surface temperature perturbations on the local thermodynamic characteristics of the atmosphere. It is found that for perturbations in the range that would be produced by Ocean Thermal Power Plants, the average temperature and specific humidity in the marine boundary layer vary linearly with the sea surface temperature with slopes of 0.8 C/C and 0.6 g/kg/C respectively. The total heat flux at the sea surface is also found to vary almost linearly with the sea surface temperature in the range with a slope of 31 cal/cm/day/C.

5539 (ANL/OTEC-BCM—006) **Investigation of the chemistry of calcium carbonate scale nucleation and growth from seawater on OTEC heat exchangers.** Morse, J.W.; Brass, G.W.; Walter, L.M.; Van Valin, R. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). Aug 1979. Contract W-31-109-ENG-38. 76p. Dep. NTIS, PC A05/MF A01.

The potential for calcium carbonate scale formation, from supersaturated seawater on candidate Ocean Thermal Energy Conversion heat exchanger tubes, has been tested under flowing and stagnant seawater, and leaking liquid ammonia conditions. It was not possible to confirm the existence of calcium carbonate in any of the deposits formed. However, the presence of calcium in the deposits, generally as a minor component, indicates that microcrystalline calcium carbonate may be formed. Tests performed on growth rates of calcite and aragonite powders in seawater indicate that the maximum thickening rate of a calcium carbonate scale, under conditions which are likely to be encountered in heat exchanger tubes, is less than 20 μm per month.

5540 (PB—293733) **Data from the Atlantic Oceanographic and Meteorological Laboratories OTEC plant site study in the Gulf of Mexico, July 1977. Technical memo.** Thomas, G.G.; Minton, S.M.; Molinari, R.L. (National Oceanic and Atmospheric Administration, Miami, FL (USA). Atlantic Oceanographic and Meteorological Labs.). Jan 1979. 137p. NTIS, PC AA07/MF A01.

Physical oceanographic data collected in July 1977 at a proposed Ocean Thermal Energy Conversion (OTEC) site in the Gulf of Mexico are presented. Data reduction techniques for all phases of the cruise are also given. The OTEC Program of the Department of Energy has a requirement for physical oceanographic data as input to the process of selecting suitable sites for the placement of a moored OTEC plant. This report lists all data collected aboard the NOAA Ship RESEARCHER during July 1977 by AOML personnel and other scientists. In addition, some XBT data collected in October and November by both the RESEARCHER and VIRGINIA KEY are included. Both plots and listings are given for all CSTD, XBT, and Current Meter Profiles. In general, description of the data processing techniques for all data sets is given to familiarize the reader with the methods involved in reducing the raw data series to its final acceptable form.

5541 (PB—294189) **Inorganic nutrients and dissolved oxygen variation determined from historical data at three proposed ocean thermal energy conversion (OTEC) sites: Puerto Rico, St. Croix, and northern Gulf of Mexico. Technical memo.** Cummings, S.R. Jr; Atwood, D.K.; Parker, J.M. (National Oceanic and Atmospheric Administration, Miami, FL (USA). Atlantic Oceanographic and Meteorological Labs.). Feb 1979. 78p. NTIS, PC AA05/MF A01.

Inorganic nutrients and dissolved oxygen concentrations from the available historical data set at three proposed Ocean Thermal Energy Conversion (OTEC) sites were reviewed. These sites are Puerto Rico, St. Croix, and northern Gulf of Mexico. Among the principal inorganic nutrients which regulate open ocean productivity are nitrate, phosphate, and silicate. It is also pertinent that biological factors predominate in determining the distribution of oxygen in the sea. Results show that dissolved oxygen and inorganic nutrients vary in a consistent manner with depth within a narrow range in the Puerto Rico and St. Croix study areas. Nutrient and dissolved oxygen variability is greater in the upper 800 m of the northern Gulf of Mexico than in the Caribbean. Nutrient concentrations at 1000 m are considerably greater than at near-surface depths. The pumping of these deep waters into the euphotic zone could cause biostimulation when conditions are right. However, this effect would be small compared to natural upwelling phenomena and probably horizontal flows past the plant would rapidly dilute upwelled nutrient to background levels.

5542 **Ocean thermal energy conversion valve.** Taylor, J.S. US Patent 4,151,977. 1 May 1979. Filed date 1 Mar 1978. 4p.

A fluid flow control valve to be interposed in the fluid passageway of a large diameter casing projecting downwardly below the ocean thermocline for moving cold water to the surface is described. The depending end portion of the casing wall is provided with inlet ports. A sleeve valve, having a length at least greater than the vertical limit of the ports, is coaxially disposed in the casing and includes spaced-apart upper and lower floatation chambers slidably contacting the casing inner wall surface for opening and closing the passageway. Inflatable seals, surrounding and supported by the floatation chambers, are selectively inflated or deflated. The floatation chambers also are selectively inflated or deflated to provide or remove buoyancy of the sleeve valve in its passageway opening and closing action. Stops, secured to the inner wall surfaces of the casing above the upper limit of the ports, prevent upward movement of the sleeve valve beyond a passageway closed position.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 5355, 5872, 5874

5543 (DOE/EV—0052/1) **Three solar urban futures: characterization of a future community under three energy-supply scenarios.** Milne, M.; Adelson, M.; Corwin, R. (Urban Innovations Group, Los Angeles, CA (USA)). Oct 1979. Contract W-7405-ENG-48. 147p. Dep. NTIS, PC A07/MF A01.

Technology assessment of solar energy systems.

This study examines a hypothetical city of 100,000 people in the year 2025 based on three initially given energy-supply scenarios: Future 1 specifying approximately 6% of the city's demand being met by solar technologies; Future 2 specifying about 25%; and Future 3 seeking maximum use of solar technologies. These three versions of the hypothetical city are to be identical in terms of population, goods and services produced, and energy demand. Their

differences are compared in terms of physical layout, environmental quality, socio-economics, and quality of life. It is concluded that in Future 1 and Future 2, the city's residential, commercial, and industrial sectors can easily meet the on-site energy-collection requirements of the given supply scenarios. In Future 3, the Solar City, the residential sector can be totally energy self-sufficient (collecting all needed energy on-site), and the commercial sector can collect 59.7% of its energy requirement. Passive design of buildings plays a large part in these results. The industrial sector can collect on-site only 18.2% of its energy needs. In what is called Future 3A, all three sectors of the hypothetical city can be 100% energy self-sufficient if the land area available for various types of solar collectors is increased 34.5%; the commercial sector needs 650 additional acres, while the industrial sector needs 2800 acres, provided that moderate temperature energy (250°F to 600°F) is adequate to meet industrial process needs.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 5515, 5516, 5659, 5797

5544 (BNL—51033) **In-house solar research and development projects. FY 1978 annual activity report, October 1, 1977-September 31, 1978.** Andrews, J.W.; Auh, P.C.; Kush, E.A.; Metz, P.D.; Wilhelm, W.G. (Brookhaven National Lab., Upton, NY (USA)). Sep 1978. Contract EY-76-C-02-0016. 38p. Dep. NTIS, PC A03/MF A01.

Since Brookhaven National Laboratory initiated new solar acitivites in 1976, various in-house solar research and development projects have been generated by the Solar Technology Group. These projects are in the areas of solar-assisted heat pumps, solar cooling, study of low-cost solar collectors, and ground-coupling heat storage. The research and development activities are in parallel with technical support to the US Department of Energy. The technical progress made during FY 1978 is described here in detail.

5545 (COO—2704-19) **Evaluation of the Solar Building, Albuquerque, New Mexico: instrumentation of building and system.** Wildin, M.W.; McLaughlin, E.R.; Gilman, S.F. (Pennsylvania State Univ., University Park (USA)). Jul 1976. Contract EY-76-S-02-2704. 12p. Dep. NTIS, PC A02/MF A01.

The instrumentation used to obtain data on the Solar Building, Albuquerque, New Mexico during the period November, 1974, through April, 1976 is described. Attention is focused on the types of instrumentation used: their principles of operation, sensitivity, range and where pertinent, installation. Locations of sensors are identified, so far as this pertains to obtaining accurate and adequate data. A list of sensors monitored in the third period is presented, as an example in appendix A. For convenience, the physical quantities measured and the type of instrument used to measure each are presented. The nature of the output from the instrument and the normal method of recording that output are also given.

5546 (DOE/CS/4131—1(Vo.3), pp 699-704) **Plymouth City Hall, Plymouth, Minnesota.** Bansal, J.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The two-story 31,492 ft² building is under construction. Installation of the solar space and water heating system is planned as a retrofit. The system will consist of 2700 ft² of flat plate liquid collectors and a 3000 gal steel storage tank and will provide 23.7% of building heating needs and 51.5% of domestic water heatig requirements. The estimated cost of the project is $157,578. (WHK)

5547 (DOE/CS/4131—1(Vo.3), pp 705-711) **Solar heating and cooling for an underground building at the University of Minnesota.** Bligh, T.P.; Ramsey, J.W. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This program is for the design and construction of a demonstration solar heating and cooling project at the University of Minnesota. A new building, Williamson Hall, was commissioned in April 1977 and has 7700 m² (83,000 ft²) of floor area, 95% of which is below ground level. The initial design of the building included those features which would allow the addition of a solar collector system. These include: a variable volume air handling system which was carefully zoned; a system to recover heat from the exhaust air; the piping runs from the roof top to the mechanical room to accommodate solar collectors; the HVAC system which uses hot water as the energy source rather than the low pressure steam normally used at the University; the size of the absorption chiller was increased to allow operation at a lower inlet temperature. These changes were funded by the University. A 613 m² (6600 ft²) SLATS concentrator solar system is currently being installed. The installation which will be completed by January 1979, will supply an estimated 50% of the annual heating and cooling energy requirements for the building. The system uses an 8000 gal steel storage tank. Total construction costs are $595,500.

5548 (DOE/CS/4131—1(Vol.3)) **Final proceedings of the second solar heating and cooling commercial demonstration program contractors' review. Volume 3. Demonstrated project papers and appendices.** Cagle, D.B. (ed.). (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Jul 1979. Contract EC-78-C-01-4131. 760p. (CONF-781220—(Vol.3)). Dep. NTIS, PC A99/MF A01.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Separate abstracts were prepared for the 102 papers included. (WHK)

5549 (DOE/CS/4131—1(Vol.3), pp 389-402) **City of Huntsville Senior Citizens' Center solar heating and hot water system.** Dickson, W.R. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design, construction, and startup of the solar space and water heating system for the 16,000 ft² building are described. The system utilizes flat collector panels tilted on the south walls and a 3000 gal storage tank. The system has operated automatically without problems since its startup on December 1, 1978. (WHK)

5550 (DOE/CS/4131—1(Vol.3), pp 403-407) **Solar Demonstration Project: Reynolds Metals Shower and Change Facility.** Foster, W.W. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar system for space heating and water heating for the 3543 ft² system is described. 2560 flat plate collector and a 5000 gal steel storage tank are used. The system cost $158,404 and has successully undergone a series of acceptance tests. Design and operation are discussed. (WHK)

5551 (DOE/CS/4131—1(Vol.3), pp 409-415) **Solar heating system: Corona del Sol High School.** Hite, M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Corona del Sol is a full service high schol with approximately 315,000 ft² of total area and 238,000 ft² heated by the solar heating system. Construction of the facility is mostly masonry and concrete with one story high berms on many of the exterior walls. The solar system is designed to provide 100% of the service hot water demands, 67.3% of the peak space heating requirements, and 88.4% of the annual space heating requirements. The system utilizes 17,500 net ft² flat plate collectors and a 47,000 gal storage tank. System cost was $789,672. The project is complete except for de-bugging and the final acceptance test. System design and operation are described. (WHK)

5552 (DOE/CS/4131—1(Vol.3), pp 417-418) **Maricopa County Court Building solar energy system.** Iannella, G. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar heating and air conditioning system for the 6800 ft² building is described. The design incorporates 2700 ft² of solar collectors and a 5000 gal storage tank. The project is currently at the bid solicitation stage. (WHK)

5553 (DOE/CS/4131—1(Vol.3), pp 419-421) **Stanford University Central Food Services Building solar space and domestic hot water heating system.** Beavers, C. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space and water heating system utilizes 840 ft² of flat plate collectors and a 1550 gal storage tank. The system is estimated to provide 70% of the yearly heating load. Final construction cost is $65,558. Construction is approximately 75% complete with completion scheduled for November 1978. (WHK)

5554 (DOE/CS/4131—1(Vol.3), pp 423-425) **Solar space heating system, Seeley G. Mudd Education Building, Pacific School of Religion, Berkeley, Clifornia.** Bovill, C. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Seeley G. Mudd Education Building at the Pacific School of Religion in Berkeley, California was planned to have a solar space heating system retrofitted on to it. The architect, Charles Stickney, AIA, retained Interactive Resources, Inc. as solar consultants early in the design process. The active solar system will

provide 36% of the space heating needs. Good orientation, overhang protected south glass and massive construction will provide for additional passive solar heating. This building, with approximately 12,400 ft² of space, and with parking garage underneath, will be built at a cost of $1,500,000. Construction began in September 1978. The target date for completion is June 1979. The design philosophy is discussed.

5555 (DOE/CS/4131—1(Vol.3), pp 427-431) **Proposed western energy office building.** Boyd, J.B. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The proposed wood frame structure (approximately 4400 ft²) will have R-11 wall, R-30 roof and R-30 floor insulation; all windows are double-glazed. The northeast facing windows and skylight provide excellent natural lighting to all interior spaces and will reduce the lighting loads. Openable windows and skylight vents provide natural ventilation for summer cooling; prevailing winds are from the northeast and should aid the ventilation by sucking warm air out of the skylight vents. South-facing windows are replaced by solar collectors to provide more even heat distribution, to prevent overheating in the summer months, and to minimize traffic noise from the adjacent freeway. The proposed solar heating system consists of hydronic flat plate collectors, a water storage tank with submerged heat exchangers, rediant heating copper floor coils embedded in concrete, solar circulation pumps, space heat circulation pumps, and electric back-up circulation heaters. The functions of the solar system are to provide domestic hot water preheating and indirect space heating. The building is not yet under construction.

5556 (DOE/CS/4131—1(Vol.3), pp 443-447) **Descanso Gardens Guild exhibition and educational arboretum and community complex.** Collins, D.L. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Descanso Gardens exhibition hall, classroom, and administrative complex is designed to provide a unique community educational facility for Los Angeles County. The buildings consist of a 4400 ft² auditorium and exhibition hall, two 1000 ft² classrooms, a 1000 ft² administrative building, and 800 ft² gift shop, a food preparation and service area, and entry control point. The aesthetics of the buildings are designed to match the woodsy arboretum atmosphere and were unsuitable for direct installation of solar collectors. The system design separates the solar collectors into a ground mount installation which conceals the collector from the visitor'e eye until brought to his attention. The entire system is designed to aesthetically blend with the complex's pristine, sylvan surroundings. The passive portion of the system provides 25% of the cooling load and 40% of the heating load for the buildings. The active solar system provides the balance of the load requirement up to an aggregate total of 87%. The project is in the design stage. The total proposed cost is $165,193.

5557 (DOE/CS/4131—1(Vol.3), pp 449-456) **Integrated solar heating, cooling, and hot water system for the San Diego City Schools' University City High School, San Diego, California.** Fergin, R.K.; Canner, R.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar heating and cooling system for the four one-story buildings comprising 185,000 ft² is described. Solar collection is 85% by parabolic tracking collectors and 15% by Fresnel lens concentrating collectors with a total field of 19,500 ft². Storage is provided in three 33,300 gal water tanks. Two 250-ton absorption chillers will be used. Site preparation is in progress and the construction contracts had not been let as of September 1, 1978. (WHK)

5558 (DOE/CS/4131—1(Vol.3), pp 457-464) **El Camino Real School Solar Project, Irvine Unified School District, Irvine, California.** King, D.E.; Smith, K.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Five thousand ft² of evacuated tube collectors are utilized to provide an estimated 55% of the space heating and cooling needs of the 41,000 ft² building. Two 100-ton Arkla, model WF-1250 absorption chillers were used. Construction was completed in March 1978. The design philosophy and installation and startup problems and experiences are discussed. (WHK)

5559 (DOE/CS/4131—1(Vol.3), pp 465-471) **Lake Valley Fire House Solar Project.** Lucas, J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Design and installation and operational problems of the solar space heating system are discribed. The firehouse requires the heating needs of a 4700 ft² residence. Problems with the storage tank are descussed. The system is presently awaiting a new storage tank. (WHK)

5560 (DOE/CS/4131—1(Vol.3), pp 485-493) **Energy-efficient State Office Building, Sacramento, California.** Setty, B.S. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Design, construction, and operation of the solar space heating and cooling system for the 27,000 ft² building are briefly described. The system utilizes 7085 ft² of flat plate collectors, two 25-ton Arkla absorption chillers, a 10,000 gal hot water storage tank, and a 50,000 gal cold water storge tank. The system has been operational since early 1977. (WHK)

5561 (DOE/CS/4131—1(Vol.3), pp 495-499) **Solar heating system for a fire station in Long Beach.** Sosoka, J.R. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar space and water heating system and a fire station with 4200 ft² of office and living space is described. The use of 277 ft² of single-pane flat plate collectors and a 500 gal storage tank are planned. Construction of the fire station and solar heating system has not begun. Only one bid was received ($900,000) which was $300,000 over the estimated cost. (WHK)

5562 (DOE/CS/4131—1(Vol.3), pp 501-506) **Church of the Valley energy system design, San Ramon, California.** Taber, W.S. Jr. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The church of the Valley is a complex of religious and community buildings which incorporates into its design a comprehensive system of energy conservation in heating, cooling, ventilating, and lighting. The solar system will utilize 714 ft² of flat plate collectors and two 550 gal steel tanks. The general design plans for the total energy conservative system are discussed. The project is under construction and completion is scheduled for Christmas 1978. (WHK)

5563 (DOE/CS/4131—1(Vol.3), pp 507-510) **Community Recreation Center solar space and water heating system.** Visioni, A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

A description of the planned retrofit solar space and water heating systems for the two-story 12,500 ft² building with a planned addition of 700 ft² of new space is given. The system will utilize 1010 ft² of flat plate collectors and a 2000 gal storage tank to provide 70% of the space heating and hot water requirements for the building. The system is still in the preliminary design stage. (WHK)

5564 (DOE/CS/4131—1(Vol.3), pp 511-512) **Celestial Seasonings solar heated office and processing building in Boulder.** Bushnell, R.H. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar space and water heating system for the processing and warehouse building with an attached office building is described. The system will utilize glass walls for the office building and both liquid-type and air-type flat plate collectors. The project is estimated to cost $383,000. Construction has not started. (WHK)

5565 (DOE/CS/4131—1(Vol.3), pp 513-517) **Telluride School: a passive hybrid retrofit.** Erdman, T.; Doud, E.; Hobbs, K.; Slack, P. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The retrofit design chosen is a glazed building envelope on the northeast and southwest sides of the classroom wing, insulating those walls while collecting and storing solar heat. A separate Trombe wall will be constructed on the southwest gym wall. Storage will be in the existing 10″ masonry walls as well as active rock storage on the northeast and southwest sides of the classroom wing. The system is predicted to provide about 40% of the school's space heating load. System design and operation are discussed. The projected cost of the project is $216,000.

5566 (DOE/CS/4131—1(Vol.3), pp 519-522) **Use of solar energy and energy conservation measures in a state-supported housing project for the elderly in Connecticut.** Eveleth, D.D. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The flat plate collectors are expected to provide 75% of the energy needs for space and water heating for the 20 units in the housing project for the elderly. There is 130 ft^2 of collector per living unit and 1600 gal heat storage capacity per four-unit building. Total construction cost for the 40-unit village was $868,471; $155,093 was for the solar systems for 20 units. Final inspection of the project was completed in July 1978; however, final testing and balancing of the system is unfinished. (WHK)

5567 (DOE/CS/4131—1(Vol.3), pp 523-526) **Danbury Hospital solar energy project.** Kuszpa, F.J. Jr. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space and water heating system utilizes 18,669 ft^2 of flat plate collectors and 47,000 gal of liquid heat storage for the 331,544 ft^2 hospital. System design and construction and design problems are discussed. The final cost was $840,646; the system is near completion. (WHK)

5568 (DOE/CS/4131—1(Vol.3), pp 527-534) **McColl-Wade, Inc. solar office building.** McColl, J.R. Jr.; Beringer, R.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space and water heating system for the 7000 ft^2 of offices, warehouse, and sheet metal shop is described. The system utilizes 1950 ft^2 of air-type flat plate collectors and 1104 ft^3 of rock for heat storage. The system is expected to provide 60 to 65% of the heating requirements. Problems encountered and lessons learned are discussed. (WHK)

5569 (DOE/CS/4131—1(Vol.3), pp 535-537) **Albie Booth Memorial Boys' Club, New Haven, Connecticut.** Sullo, R. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space and water heating system for the one-story 35,000 ft^2 building is briefly described. The system will utilize 3150 ft^2 of solar collectors to provide approximately 40% of the space heating needs and 56% of the hot water needs of the building. The system is in the final stages of construction. (WHK)

5570 (DOE/CS/4131—1(Vol.3), pp 539-540) **Village Street office building, North Haven, Connecticut.** Sullo, R. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Plans for construction of a solar space and water heating system for the two-story 23,500 ft^2 office building are discussed. The system will employ 2100 ft^2 of flat plate collectors and two 2000 gal storage tanks to provide approximately 75% of the building heating load. The project is in the final design stage; proposed total cost is $157,530. (WHK)

5571 (DOE/CS/4131—1(Vol.3), pp 541-547) **Wilmington Swim School solar system.** Breck, T.T.; Cooperson, J.N.; Kursh, S.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned hybrid active/passive solar heating system for the two-story 20,650 ft^2 swim school is described. The active system is designed to provide 67% of the space heating, 62% of the domestic hot water, and 18% of the pool heating requirements; it will utilize 2500 ft^2 of flat plate collectors and a 2800 gal storage tank. The passive system will utilize 240 ft^2 of south-facing vertical-wall air collectors. The project is under construction; total budget is $124,158. (WHK)

5572 (DOE/CS/4131—1(Vol.3), pp 559-566) **Florida Welcome Station solar heating and cooling project.** Sechler, T.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space heating and air conditioning system under construction for the welcome station is described. The system utilizes 2720 ft^2 tracking Fresnel lens concentrating collectors, a 25-ton Arkla absorption chiller, a 6000 gal hot water tank, and a 6000 gal chilled water tank. The original construction cost was $246,000; additional fees and charges are expected to amount to $61,600. (WKH)

5573 (DOE/CS/4131—1(Vol.3), pp 567-573) **Solar office building, Reedy Creek Utilities Co., Inc., Walt Disney World.** Smith, W.K. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

In November 1977, the utility company servicing Walt Disney World put into operation a new two-story office building, specifically designed for a unique solar enery system. Solar energy powers air conditioning, space heating, and potable hot water supply. The solar collectors are the roof of the building. They are horizontal parabolic mirrored troughs which focus on tracking absorbers, moving in one dimension, and water cooled. The chiller is a commercially available 25-ton lithium bromide absorption unit and utilizes an existing cooling tower system as the heat sink. The building has 5625 ft^2 of air conditioned space and the collector area of the roof is 3840 ft^2. System design, operation, and performance are discussed. The total project cost was $1,049,432.

5574 (DOE/CS/4131—1(Vol.3), pp 575-583) **North Georgia Area Planning and Development Commission Headquarters Building - solar cooling, heating, and hot water demonstration project.** Sutherland, G.; Kolberg, D.W. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space heating, water heating, and air conditioning system used in the two-story 7000 ft^2 building is described. 2001 ft^2 of flat plate collectors, a 3000 gal hot water tank, a 5000 gal chilled water tank, and a model 300 Arkla absorption chiller are utilized. The system was operational in May 1978; the total solar system cost was $142,671. (WHK)

5575 (DOE/CS/4131—1(Vol.3), pp 585-593) **Shenandoah Solar Recreational Center.** Williams, J.R.; Craig, J.I. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Shenandoah Solar Recreational Center, when completed early in 1977, was the world's largest building to have most of its heating, air conditioning, and domestic hot water needs met by solar energy. The building incorporates 11,213 ft^2 of double glazed black chrome selectively coated copper tube-in-strip flat plate solar collectors oriented at an angle of 45° to the south with 23,000 ft^2 of highly polished aluminum reflectors to provide energy for heating and air conditioning the 59,000 ft^2 community center. Each of the 63 solar collectors are 8.61 ft high and 20.7 ft wide with the copper tube-in-strip absorber plates insulated on the back side to a K value of 0.05 $Btu/ft^2/°F/h$. Thermal storage is provided by a 15,000 gal hot water storage tank, a 2200 gal buffer tank, and two 30,000 gal chilled water storage tanks. The large tanks are buried beneath the earth berm surrounding the sides of the building. The system was designed to supply 64% of the cooling, 95% of the heating, most of the domestic hot water and pool heating. The building has been operating since early April 1977. Data taken by IBM indicates the building is supplying as much as 96% of the combined heating and air conditioning load. A failure of the freeze protection system in December 1977, caused the system to be inoperable until repairs were completed in April 1978. The installed cost of the solar system was $538,505.

5576 (DOE/CS/4131—1(Vol.3), pp 599-601) **Solar energy system for space heating and space cooling.** McNamara, T.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design philosophy of the retrofit solar system for 70,000 ft^2 of the Museum of Science and Industry in Chicago, Illinois, is described. The system will utilize 7072 ft^2 of evacuated tube collectors, and absorption chiller, and a 3000 gal storage tank to provide 29% of the annual space heating requirements and 44% of the annual cooling requirements. The system is being installed. (WHK)

5577 (DOE/CS/4131—1(Vol.3), pp 603-607) **Solar suites: a medical office building solar system review.** Chiplis, T.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The building has two floors with a total of 18,000 ft^2 and a partial basement of 3400 ft^2. The planned solar system will consist of 3213 ft^2 of air-type flat plate collectors and a 3384 ft^3 crushed rock bin. Construction is scheduled to begin in November 1978. (WHK)

5578 (DOE/CS/4131—1(Vol.3), pp 609-615) **Solar energy retrofit for Clarksville Middle School, Clarksville, Indiana.** Galbreath, J.W.; Spaulding, M.F. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar heating system for two gymnasiums in the school is described. The system will incorporate 6520 ft^2 of flat plate collectors and a 10,000 gal steel storage tank. System installation has not been completed. The cost of the project is $282,000. (WHK)

5579 (DOE/CS/4131—1(Vol.3), pp 617-623) **Longfellow School, Marion, Iowa.** Hynes, J.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design, installation, and initial operation of the retrofitted solar space heating system for the 11,000 ft^2 building are discussed. 4896 ft^2 of flat plate collectors and an 8000 gal storage tank are employed. Installation problems are discussed. The total system cost was $242,223. (WHK)

5580 (DOE/CS/4131—1(Vol.3), pp 625-626) **Johnson County Jail, Iowa City, Iowa.** Schoenfelder, J.L. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The facility incorporating the solar heating system is the Johnson County Jail in Iowa City, Iowa. The jail will be a new facility of approximately 31,672 ft^2 of which 23,264 ft^2 feet will be conditioned. The annual heating load is calculated to be 2790.2 x 10^6 Btu; the cooling load is 768 x 10^6 Btu (no solar cooling); and the domestic hot water load is estimated at 371.2 x 10^6 Btu. Solar energy will be used for space heating, ventilation air pre-heating and domestic hot water pre-heating. Total solar participation for the above mentioned items ranges from 8.2% in December to 32.4% in September. In addition the 108 collectors (1857.6 ft^2 effective area) will be used at night as stationary plate heat exchangers to provide additional exhaust air heat recovery to increase the system performance to 20.0% in December and 37.3% in September. The project is in the design stage; estimated project cost is $142,968.

5581 (DOE/CS/4131—1(Vol.3), pp 627-629) **Du-Cat Office and Warehouse, Kansas City, Kansas.** Duval, T.D. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

From the outset the Du-Cat Office and Warehouse had been planned to have the flexibility to accommodate the space needs of future tenants and to offer a real savings in heating and cooling operational costs. The building is 100 ft deep and 488 ft long with a floor-to-steel joist height of 22 ft. The long axis of the building is from north to south. The collectors are arrayed on the roof of the building in 20 rows with 20 collectors per row. The original solar system was designed to meet a percentage of the heating requirements for the warehouse portion of the building only. It is estimated that the solar system will supply 56.2% of the heating requirements of the warehouse area. The warehouse was designed to take up 39,000 ft^2 of the building. The building envelope is well insulated in that it has an R-20 roof and an R-11 sidewall. Comparatively, the energy required to heat the building without solar will be 30 to 35 % less than a similar building built under normal construction standards in the Kansas City area. There is no thermal storage system other than the thermal mass of the building and its contents. The total cost of the solar system and structural changes to accept the system is approximately $345,000.

5582 (DOE/CS/4131—1(Vol.3), pp 631-636) **Citizens Mutual Savings Association, Leavenworth, Kansas.** Perkins, R.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar system is designed to provide 100% of the domestic water heating, 91% of the space heating, and 70% of the space cooling needs for the conditioned 9000 ft^2 of the 12,000 ft^2 two-story building. The system utilizes 2220 net ft^2 of flat plate collectors, a 3000 gal hot storage tank, a 3000 gal cold storage tank, five solar-assisted heat pumps, and five three-ton absorption chillers. (WHK)

5583 (DOE/CS/4131—1(Vol.3), pp 637-642) **Comparison of a liquid and an air solar heating system applied to the same structure as applied at Rademaker Corporation, Louisville, Kentucky.** Rademaker, R.W. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The building has a total area of 10,000 ft^2. The liquid solar system employs ethylene glycol fluid in 240 ft^2 of collectors with a 560 gal storage tank. The air system uses 195 ft^2 of collectors and 110 ft^3 of one-inch diameter washed river gravel for storage. The operation, operational experience, and performance of the systems are discussed. (WHK)

5584 (DOE/CS/4131—1(Vol.3), pp 643-648) **Solar heating for field house, Louisiana State University, Baton Rouge, Louisiana.** Evans, W.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design and operation of the solar space and water heating system for the 101,000 ft^2 building is described. 5560 ft^2 of flat plate liquid collectors and a 10,000 gal steel storage tank are incorporated. The system is expected to provide approximately 28% of the total annual space and water heating load. Construction of the system was completed in July 1978 at a cost of $345,503 not including professional design costs. (WHK)

5585 (DOE/CS/4131—1(Vol.3), pp 649-651) **Northeast Carry passive solar retrofit.** Poitras, R. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Northeast Carry building is a standard 100 year old brick building located on the banks of the Kennebec River in historic Hallowell, Maine. The building houses offices and a small store in 800 ft^2 of floor space. Although the initial proposal for retrofitting the Northeast Carry building consisted of a simple double glazed kalwall covering for the structure's exposed 800 ft^2 southwest wall, the lack of clear, precise boundaries between properties, and resistance from adjacent property owners and Hallowell's historic community necessitated the shift in the proposal as outlined herein. The redesigned collector will enclose approximately 200 ft^2 of the southeast face of the building which is not readily visible from the street and is directly adjacent to the property leased by Northeast Carry. The proposed collector will provide an estimated 30% of the building's heating requirements. The system is now in the final design stages with completion projected for December 1978. Labor costs are projected at $2280, materials at $1509, administrative reports and other miscellaneous costs bring the total project costs to $10,312.60.

5586 (DOE/CS/4131—1(Vol.3), pp 653-659) **Policy, decision making, financing, and engineering issues in solar energy applications, Germantown Campus, Montgomery Community College.** Dueber, E.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The decision making process that lead to the construction of the solar space and water heating systems for the Sciences and Applied Studies building and the Social Sciences and Humanities Building of Montgomery Community College in Maryland is described. The architect/engineer optional designs, project bids, costs, and construction schedules are discussed. (WHK)

5587 (DOE/CS/4131—1(Vol.3), pp 661-670) **Solar Energy System design, Upton Multipurpose Center, Baltimore, Maryland.** Parker, A.J. Jr.; Hedden, R.E.; King, T.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The system utilizes 3100 ft^2 of single-glazed non-selective flat plate collectors, a 20,000 gal storage tank, and water-to-air heat pumps. The system is under construction; completion is scheduled for December 1978. The bid price was $104,000. (WHK)

5588 (DOE/CS/4131—1(Vol.3), pp 671-674) **Town of Concord, Massachusetts, solar space heating project at the Municipal Light Plant building.** Hartwell, D.W.; Minty, J.G. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Town's solar project is an air space heating system. It has been retrofitted to our Municipal Light Plant Building, a one-story masonry block structure with a flat roof and concrete floor. The building is used for both office and warehouse functions. Orientation is slightly west of due south in an open area. The solar system is being used to heat 2700 ft^2 of office space and 5700 ft^2 of warehouse area. It is estimated that the 1932 gross ft^2 of collectors will supply approximately 70% of the annual heating load. Backup heat is supplied by existing unit heaters. Construction was completed in March 1978, but, due to problems with the collectors, did not become fully operational until October 1978 (the preparation date of this paper) and therefore do not have substantive operational data as of this writing. Construction cost was $118,050.

5589 (DOE/CS/4131—1(Vol.3), pp 675-677) **Fern Engineering Co., Inc., Solar Space Heating System, Bourne, Massachusetts.** Levine, P. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Seven-hundred-fifty ft^2 of air-type flat plate collectors are used with two 375-gal hot water storage tanks to supply 58% of the heating load for the office building which is approximately 6000 ft^2. Total construction cost per ft^2 of collector (including storage, heat exchangers, controls, and installation) was $33.90. The acceptance test is slated for January 1979. (WHK)

5590 (DOE/CS/4131—1(Vol.3), pp 679-683) **Solar heating experiment on the Grover Cleveland School, Charles Street, Boston, Massachusetts.** Mulkern, J.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Grover Cleveland School was the first solar heating experiment on a Public School to come on line for continuous operation in the US when heat was supplied on March 6, 1974. The system utilizes 4600 ft^2 of hydronic collectors and a 2000 gal storage tank to supply approximately 68% of the space heating needs for 21,000 ft^2 of the school building. Operational experience and problems are discussed. The original system cost $354,000 in 1974; modifications cost $66,000. (WHK)

5591 (DOE/CS/4131—1(Vol.3), pp 685-691) **Solar heating and hot water system for the Technology Properties Trust Building, Burlington, Massachusetts.** Zvara, J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Technology Properties Trust office building is a new, energy-efficient, multi-tenant office building located in the northwest suburbs of Boston. Construction of the three-story structure was completed in November 1977. The design incorporated energy conservation techniques throughout, exceeding the guidelines of ASHRAE Standard 90-75 in every respect. Provision for incorporation of a solar heating and hot water system was made in the initial design. This included an oversize mechanical room for housing solar storage tanks, heat exchangers, pumps, etc.; installation of solar heat and hot water system supply and return pipes in the walls from the roof to the mechanical room; use of steel beams in the roof designed to support future solar collectors and reflectors; installation and water proofing of 72 steel support columns for roof mounting of the solar collectors; and installtion of a standard stairway to the roof. The roof-mounted system includes 90 flat plate collectors augmented by flat reflectors. The reflectors are hinged to permit their use as protective covers for the solar collectors during the summer months. Two 3000 gal storage tanks located in the mechanical room are interconnected to provide maximum thermal stratification. Heating and cooling is provided to the individual offices by distributed fan coils supplied by a four-pipe system. Back-up heating and primary cooling are provided by a well-water supplied water-to-water heat pump. The solar hot water system was completed and began operations in October 1978. The solar space heating system is in final stages of installation and checkout and is scheduled to begin operations in January 1979.

5592 (DOE/CS/4131—1(Vol.3), pp 693-697) **Integrated solar space heating for the Walter R. Bemis Elementary School.** Andringa, G. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Bemis Elementary School is one of three identical buildings being built within the school district. Designed to accommodate 600 students, the single story building contains twenty classrooms, a large media center, gym, cafetorium, public branch library, and related support spaces within 61,000 ft^2. Foam-in-place insulation (4") within the exterior masonry laionavity walls, double glazed window areas and 3-7/16" thick fiberglass/urethane roof insulation provide a "thermos bottle" environment which will not require heat from an auxiliary source during occupancy unless outdoor temperatures fall below 8°F. The solar system provides 40% of the total heating load. The system utilizes 5000 ft^2 of flat plate liquid collectors, a 40,000 gal concrete storage tank, and water-to-air heat pumps. Building construction began in July 1977, and is scheduled for completion in November 1978. (WHK)

5593 (DOE/CS/4131—1(Vol.3), pp 713-720) **Solar system for Radisson Plaza Hotel.** Erickson, D.D. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The 16-story 250 room hotel is under construction and it is expected that the solar system will be installed near the end of 1979 and be operational early in 1980. The solar system was designed to provide a significant proportion of the hot water needs and for he ventilation air of the guest rooms; combined, they will provide approximately 48% of the hot water and ventilation air heating demands. The water heating system will utilize 4062 ft^2 of liquid flat plate collectors, and the space heating system will utilize 2468 ft^2 of air-type collectors. Two 4500 gal water tanks will be used for heat storage. Total cost for the system is estimated at $400,000. (WHK)

5594 (DOE/CS/4131—1(Vol.3), pp 721-727) **Paulucci Planetarium, Hibbing Community College, Hibbing, Minnesota.** Sandberg, R.Y. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space and water heating system under construction for the 4850 ft^2 building is described. The system utilizes 3600 ft^2 of line-focusing concentrating collectors, a 225,000 gal water storage tank, and water-to-air heat pumps to provide an estimated 91% of the heating needs of the building; the design philosophy is discussed. (WHK)

5595 (DOE/CS/4131—1(Vol.3), pp 729-734) **Minnesota Zoological Garden Solar Energy Exhibit.** Young, W.A.; Peterson, R.L. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

For the most cost effective utilization of solar energy this demonstration project provides a solar heating system which has been sized to provide space heating and domestic hot water requirements. The initial system utilizes 460 hydronic flat plate collectors totalling 8280 ft^2. The solar system is designed to provide 25% of the present connected heating needs and 24.8% of the domestic hot water needs. Although this system is capable of providing space heating requirements for five animal holding buildings adjacent to the solar facilities, for budgetary reasons this was not included with the first phase development. However, portions of the underground distribution to those buildings are provided under the hard-surfaced areas of the complex walkway system. This will be used for future expansion of the system. The system will utilize 8280 ft^2 of flat plate collectors and three 4626 gal steel tanks for storage. It is anticipated that construction will be complete and ready for testing by December 30, 1978. (WHK)

5596 (DOE/CS/4131—1(Vol.3), pp 735-738) **Security State Bank, Starkville, Mississippi.** Alperin, A.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar space heating system for 788 ft^2 building is described. The system will use 312 ft^2 of air-type flat plate collectors and 96,2 ft^3 of rock for heat storage. The total cost is approximately $16,000. Installation has not begun. (WHK)

5597 (DOE/CS/4131—1(Vol.3), pp 739-742) **Clarksdale Solar Bank.** Alperin, A.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space heating system for the 2150 ft^2 building will utilize 468 ft^2 of air-type flat plate collectors and 285 ft^3 of rock bed storage. The design philosophy and operation of the system are discussed. The system has not been installed; total cost is approximately $17,500. (WHK)

5598 (DOE/CS/4131—1(Vol.3), pp 743-746) **Kansas City, Capital of the Age of Enlightenment.** Chelnov, M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The building is a two-story, motel-type building. The residential wings are double loaded corridors. Meeting and dining spaces are located centrally and at the ends. The building is 266 ft long, 45 ft wide, with a total area of 24,000 ft^2. The solar system heats the 15,000 ft^2 in the residential wings. Some 78% of their seasonal heating load will be met by the solar heating system. This will be 52% of the total building heating load. The system utilizes air-type flat plate collectors and rock bed storage. Total cost of the system is $64,344; it is presently in the design stage.

5599 (DOE/CS/4131—1(Vol.3), pp 747-752) **Solar heating system, Stephens College Visitors Center.** Henley, M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This 15,000 ft^2 building, measuring 40 ft by 90 ft, with four floors, is centrally located on a college campus and is to function as a visitors center. The main floor houses the Admissions Office, which is generally the first stop for campus visitors. Below this floor is the mechanical equipment area and a 40 ft x 40 ft room, with a separate out-side entry, that will be the Faculty Club. The two floors above the Admissions space are guest rooms. A two story gallery adjacent to the guest rooms will serve to display student and faculty works of art. The Visitors Center was designed especially for a solar energy application, and as such, special care was taken to reduce the heating and cooling loads. Similarly, the solar system was designed to be as efficient as possible. The building construction is about 90% complete at this writing, and it is expected that the solar system will provide about 50% of the heating requirements. The projected completion date for the building is December 1978. The system

utilizes 3170 gross ft² of flat plate liquid collectors and a 5000 gal steel tank storage unit. The low bid for the solar system was $140,539.

5600 (DOE/CS/4131—1(Vol.3), pp 753-756) **Fire Station No. 24, Kansas City, Missouri.** Shaughnessy, C.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Fire Station No. 24 consists of 8800 ft². Of this 8800 ft², 6000 ft² is in the apparatus bay with a winter design temperature of 50° and 2800 ft² of living quarters with a winter design temperature of 70°. The solar system is an air system developed by Solaron Corporation located in Denver, Colorado. The system provides for 47% of the annual space heating requirements. There are 3 arrays of collectors totaling 2808 ft². The storage system consists of a concrete box 34' long by 7' wide by 6' tall containing 1428 ft³ or approximately 71 1/2 tons of 3/4" - 1" diameter rocks. The system is expected to be operational in February 1979. Solar system cost is $130,369.

5601 (DOE/CS/4131—1(Vol.3), pp 757-759) **Solar heating demonstration project description: Young Men's Christian Association of Hastings, Nebraska.** Innes, V.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Hastings YMCA building is a completely new facility containing an indoor swimming pool, a gymnasium, four handball courts, exercise and meeting rooms, and office and locker facilities. The building contains approximately 48,000 ft² of enclosed area. The building was placed under construction in July of 1978. The solar system will utilize 3080 ft² of flat plate collectors and a 4600 gal storage tank. It is expected to provide approximately 20% of the total energy requirements. The system is in its early stages of construction; total cost is $142,245.

5602 (DOE/CS/4131—1(Vol.3), pp 761-763) **Solar configuration and design philosophy for Headquarters of Contemporary Systems, Inc.** Christopher, J.C. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar system will utilize 800 ft² of air-type collectors with 860 ft³ of rocks in the active heating system. The passive systems includes an attached greenhouse/foyer and south facing windows. The active system will also be used for night-air cooling. The design philosophy and operation of the system are discussed. (WHK)

5603 (DOE/CS/4131—1(Vol.3), pp 765-770) **Washington Press.** Becht, C. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The building is a new, steel-framed, single story construction with an internal mezzanine. The exterior panels are brick cavity with 8-in. backup and 1 1/2-in. insulation in the cavity, with a minimum of window area. The roof deck is 3-in. light-weight insulating concrete with 1-in. rigid insulation on top. The pitched roof will be covered with metal with batten seams, and the flat section will have built-up roofing. The building is rectangular in plain view, being 210 ft by 160 ft. The roof is on a 45° axis to conform with the desired southern exposure for the collector area. The gross building floor area is 32,698 ft². There is 6076 ft² heated-only and 26,622 ft² heated and air conditioned. The heating and air conditioning system utilizes two heating-only zones and seven heating and cooling zones. Four pipe-circulating water loops serve two coils in each heating and cooling zone, and one coil in each heating-only zone. Insulated steel cabinets enclose blowers which circulate the air through the coils and distribution ductwork to the habited areas. The solar system utilizes 4882 net ft² of evacuated tube collectors, two Arkla 25-ton absorption chillers, and a 7500 gal steel storage tank. The building is presently under construction; the solar system cost is $250,000. The system is expected to provide 100% of the hot water needs and 60% of the heating and cooling needs.

5604 (DOE/CS/4131—1(Vol.3), pp 771-776) **Solar space heating and domestic hot water for the Cherry Hill Inn, Cherry Hill, NJ.** Colm, H. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The retrofit solar heating system for the 600-guest hotel with a convention center that accommodates 4000 people is described. 5733 gross ft² of evacuated tube collectors and 7500 gal stainless steel storage tank are used. The design philosophy and operation are discussed. The fraction of space heating and water heating load are tabulated for each month; the annual fraction of load supplied by solar is 34%. (WHK)

5605 (DOE/CS/4131—1(Vol.3), pp 777-793) **Passive solar space heating and active domestic hot water for the Princeton Education Center at Blairstown.** Fraker, H. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The passive solar space heating system using Trombe walls and the active solar water heating system using flat plate collectors for the Center is described. The Center is divided into two components: an 1800 ft² Maintenance Facility and a 10,000 ft² Staff and Visitors Quarters. The system is not yet under construction. Design, operation, and cost of the system are discussed. Heat loss calculations and performance data are tabulated. (WHK)

5606 (DOE/CS/4131—1(Vol.3), pp 795-798) **Friends of Animals solar space heating system, Tinton Falls, NJ.** Gilvary, P.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The 5200-ft² corporate office-neuter/spay clinic reflects Friends of Animals' environmental objectives in both its energy-maximizing features and its overall esthetics. The solar collection system has been designed to supply 60% of required heating and 100% of the domestic hot water. Passive principles, including use of masonry to create heat sinks and use of earth berms as both insulation devices and collectors of the earth's latent heat, should aid the effort in lessening the building's dependence on conventional forms of energy. THe multi-sided form that the masonry, steel, and wood structure takes developed in response to the need for an unobtrusive mass that would supply ample surface for the solar collectors but, at the same time, provide thermal characteristics that would minimize heat loss in winter and heat gain in summer. The system utilizes 1920 ft² of flat plate collectors and two 1000 gal steel storage tanks. The system is in the final stages of design. A schematic of the system is included.

5607 (DOE/CS/4131—1(Vol.3), pp 799-802) **Somerset County Environmental Education Center building solar energy system operational experiences.** Jones, W.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The general design and preliminary performance data for the solar space heating, water heating, and air conditioning system for the 18,000 ft² building are discussed. The system utilizes 3105 ft² of flat plate collectors, one 2000 gal and one 4000 gal storage tank, and an Arkla WF-300 absorption chiller. The solar system was put into operation on October 15, 1976. (WHK)

5608 (DOE/CS/4131—1(Vol.3), pp 803-809) **Contractor's review for a new 40,000 ft² hydronically operated, solar heated and air-conditioned Control Value Mfg. Facility located in southern New Jersey.** Little, R.K. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar system utilizes 6000 ft² of double glass glazed, flat plate, Sun Works collectors; four 10,000 and two 5000 gal stainless steel storage tanks; and two 25-ton Arkla absorption chillers. Technical and institutional problems are discussed. The solar system has not yet been constructed. (WHK)

5609 (DOE/CS/4131—1(Vol.3), pp 819-824) **Animal control center addition.** Dexter, M.E.; Mueller, W.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The 4300 ft² kennel is heated by solar direct gain and the concrete slab is kept warm by radiant piping in the floor using solar collectors. The 2200 ft² of office space is heated using 425 ft² of collectors and a 1500 gal storage tank. The system has been operational since March 1978. The passive heating system cost $10,490 and the active system cost $32,530. (WHK)

5610 (DOE/CS/4131—1(Vol.3), pp 825-832) **New Mexico Department of Agriculture solar heated and cooled building.** Fenton, D.; LaPlante, D.; San Martin, R.L. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The 25,534 ft² New Mexico Department of Agriculture (NMDA) building became operational during the early fall of 1975. Subsequently, an instrumentation system was designed and installed on the NMDA building to determine the performance of the solar system. Performance data for the heating mode includes the 1976-77 winter heating season. The collected data show that the heat load fraction provided by the solar system approaches unity. Cooling system performance was evaluated for the month of August 1977.

The solar contribution to the cooling load was calculated as 30% including parasitic electrical energy. The economic analysis indicates that due to unique circumstances, the new added cost of the solar system was $29,600 resulting in a payback period approximately equal to 4 years.

5611 (DOE/CS/4131—1(Vol.3), pp 833-839) **Nambe Pueblo Community building solar system.** Murray, H.S.; Moore, S.W.; Balcomb, J.D. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The structure is of single story construction located adjacent to the existing community building. The 3000 ft^2 space is used for tribal offices and a classroom. It is built of adobe with 14-in. walls. Foam insulation protected by stucco exterior is used to improve heat retention of the exterior walls. The mass of the adobe provides a large heat capacity to reduce temperature fluctuations inside the building, and large window areas also act as passive solar collectors with the adobe walls serving as heat storage. The heating system is basically an air system using rock bed storage. However, the design departs from the traditional approach in which the collectors are installed on an optimum south-facing slope. The Nambe system uses a vertical collector with a horizontal reflector. The 440 ft^2 solar collector comprises the south wall of a narrow second story room running the length of the north edge of the building. The collector consists of four 3 1/2 x 20 in. air ducts stacked on edge. The air flows in through two of these ducts and returns through the other two. Solar heat is absorbed on the black-painted surface of the air ducts. One sheet of tempered glass covers the air ducts. The reflector is 16 x 66 ft and constructed of Coilzak aluminum. Air flows from top to bottom in the 17-ton rock storage bin when collecting and storing heat. The system became operational during the 1977-78 heating season; solar sysem cost was $33,000. System operation and performance are discussed.

5612 (DOE/CS/4131—1(Vol.3), pp 841-843) **Solar heating project - Dayton T. Brown, Inc., Bohemia, New York.** Herlihy, J.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar heating system for the 66,000 ft^2 of flat plate collectors and a 5000 gal steel storage tank. The system has been operating for one month as of this writing. Design and construction are briefly discussed. (WHK)

5613 (DOE/CS/4131—1(Vol.3), pp 849-855) **Ballston spa central school district solar heating and hot water demonstration project.** May, B.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The enegy conservation package and the solar space and water heating system for the one-story 136,000 ft^2 building are described. The solar system will utilize 18,000 ft^2 of flat plate collectors and two 15,000 gal storage tanks. Construction has not yet begun. The design philosophy and problems are discussed. (WHK)

5614 (DOE/CS/4131—1(Vol.3), pp 857-863) **Grayview Building solar energy installation.** Meyer, J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The proposed site for the installation of a retrofit, closed loop, solar space heating and domestic hot water system, is the Grayview Building, located at 2 Lakeview Avenue, Lynbrook, New York. The Grayview Building is a one story, 5000 ft^2 office building with heated facilities in the basement area, presently occupied by a Consulting Engineering firm. The system will utilize 225 ft^2 of flat plate collectors and a 320 gal storage tank. System design is discussed. The project is in its preliminary design phase. (WHK)

5615 (DOE/CS/4131—1(Vol.3), pp 865-871) **Description of a retrofit solar heating, cooling, and hot water system for an urbn mixed use building.** Wertz, S.; Grunig, J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar energy system will be installed in an existing five-story and cellar commercial and residential building located in the mid-West side of Manhattan. The building is typical of the mixed use buildings in older urban areas. It houses moderate income families in seven apartments in the upper stories and accommodates local businesses in the lower one and one-half stories and cellar, including a restaurant, small bakery, two small stores and an office. The building covers almost the entire site on a south- and west- facing corner lot, and is about 25 ft by 85 ft high above the curb, 2190 ft^2 per floor, containing a total of about 13,140 gross ft^2. It was solidly constructed in 1885 of 12-in. brick bearing walls with a furred space and plaster on the interior, and with wood joist floor and roof framing; is still structurally sound; and is currently being restored and renovated. The solar system will utilize 1336 net ft^2 of evacuated tube collectors, six 500 gal storage tanks, and a 25-ton absorption air conditioner. Solar system design is discussed. The system is estimated to cost $250,000. (WHK)

5616 (DOE/CS/4131—1(Vol.3), pp 873-876) **Solar for area health and education center.** Abernethy, L. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar system installed was a retrofit to the 6-story Area Health and Education Facility which was under construction at the time of the grant application. The existing heating system was an all-air perimeter system with approximately 240 kW of electric resistance heat. The cooling system is an all-air variable volume system with 175 tons of electric centrifugal refrigeration and a 100% outside air economizer cycle to provide cooling for interior spaces when outside air temperatures allow. The retrofit consisted of adding a hydronic space and domestic hot water heating system with underground storage to the above system. The collector array consists of 171 General Electric Type FP collectors with single LEXAN cover at a cost of $49,590 for the 3950 ft^2. The calculations indicate the system should provide 52.5% of the total yearly energy requirement for heating which is approximately 709 MMBtu per year. This breaks down to approximately 39.5% of the space heating requirements and 78.6% of the domestic water requirements. Freeze problems are discussed.

5617 (DOE/CS/4131—1(Vol.3), pp 877-884) **Basin Electric Headquarters Building solar heating demonstration, Bismarck, North Dakota.** Dunham, G.F. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The retrofitted solar space heating system for the four-story 75,000 ft^2 office building is described. 5000 ft^2 of flat plate collectors and a 20,000 gal steel storage tank are used. Design of the system is discussed. (WHK)

5618 (DOE/CS/4131—1(Vol.3), pp 885-886) **Jamestown College solar heating and domestic hot water system, Lifetime Sports Facility.** Steller, R.M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The new Lifetime Sports Facility is being designed in accordance with all energy conservation codes including ASHRAE 90-75. The new facility will be a two story structure of 60,000 ft^2 with the first story earth-bermed except for the entrances and exits. The design of the new Lifetime Sports Facility is currently in the design development state and will proceed into working drawings within a 30 day period. The current schedule calls for ground breaking and construction to start on March 1, 1979. The design of the Solar Energy System is currently in the preliminary design stages. The current schedule provides for proceeding into final documents and working drawings on December 1, 1978. The final documents will be ready for ground breaking and construction to start on March 1, 1979. The remainder of the construction of the Solar Energy System will proceed concurrently with the construction of the Lifetime Sports Facility. The Solar Energy System will include 8000 ft^2 of collector area located on the ground adjacent to the structure and a 12,000 gal storage tank either directly buried adjacent to the collectors or installed in a mechanical room within the building. Flat plate solar collectors will be used. Total cost of the system will be approximately $410,000. (WHK)

5619 (DOE/CS/4131—1(Vol.3), pp 887-893) **Solar energy heating and cooling of an academic building on the Columbus Technical Institute Campus.** Jordan, R.W.; Pearson, R.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar energy heating and cooling system is being installed at a cost of $332,641 as part of new construction of a college building. The building will house classrooms, laboratories (photography, fire science and criminalistics), developmental education facilities, resource centers for hearing and visually impaired students, administrative offices and three lecture halls. The building will contain 33,830 net assignable ft^2 of area and 47,900 gross ft^2 of area. The main portion of the building is rectangular and three stories tall with a two-story trapezoidal wing along one length. The solar system will utilize 4096 gross ft^2 of evacuated tube collectors, a 5000 gal steel storage tank, and an absorption chiller. Computer modeling of the system by the University of Dayton Research Institute predicts that the solar energy system will provide 78.6% of the

building's annual heating requirements and 27.0% of the building's annual cooling requirements.

5620 (DOE/CS/4131—1(Vol.3), pp 895-899) **Solar-assisted year 'round environmental control of a development and standards laboratory.** Pearson, R.; Pliemann, N. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The building involved is a 5500 ft^2 development and standards laboratory, constructed in 1968 as an addition to an existing 52,000 ft^2 one-story facility with extremely demanding, temperature, humidity and air movement requirements for Standards Labs., Gaging Labs., and Production Areas. In addition, considerable exhaust is utilized, requiring approximately 50% fresh air. Although the building is quite well insulated and contains no glass, the considerable amount of fresh air and the use of reheat for humidity control cause the heating system alone to consume approximately 302,000 $Btu/ft^2/y$, with over 25% of this amount being consumed in the five summer months, May through September. The building mechanical service are concentrated in a penthouse and employ a built-up air handling system circulating 18,000 cfm. This quantity is constantly preheated or precooled to 53°F, after which it is distributed as necessary to condition each of eight zones via a hot deck/bypass deck multizone configuration. Preheat and reheat energy is provided 12 months per year by a hot water system, with heating energy from a central steam system. Cooling is provided by a local, electric, air cooled, reciprocating water chiller. The retrofit solar system being installed is intended to reduce preheat and reheat energy requirements for the building approximately 84% in July and 14% in January, for an annual total solar contribution of approximately 40%. Construction of the solar system has not begun.

5621 (DOE/CS/4131—1(Vol.3), pp 901-909) **Troy-Miami County Public Library.** Pearson, R.J.; Minardi, J.R. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The retrofit solar heating system using 3264 ft^2 of evacuated tube collectors and a 5000 gal steel storage tank for providing approximately 70% of the space heating needs for the 23,200 ft^2 building is described. The design and operation of the system are discussed. The system has been installed and will be operational for the 1978-79 heating season; total cost was $352,229. (WHK)

5622 (DOE/CS/4131—1(Vol.3), pp 911-916) **Solar system for Keith Keesecker Office Building, Sweet Home, Oregon.** Bliege, C.L. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar space heating, nocturnal cooling, and water preheating system for the two-story 4000 ft^2 office building is described. The system utilizes 840 ft^2 of air-type flat plate collectors and 6912 lb of Glauber's salt for latent heat storage. It is expected that the system will provide 66% of the annual space heating and water heating needs and 34% of te annual cooling needs. System startup is projected for February 1979 at a cost of $48,000. (WHK)

5623 (DOE/CS/4131—1(Vol.3), pp 917-925) **Landmarks Office Building, Pittsburgh, Pennsylvania, solar retrofit for space heating and domestic hot water.** Gottardy, J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This building is an existing 310,000 ft^2 seven-story former warehouse to be renovated and adaptively reused as an office building with commercial space on the first floor, all grouped about a planned seven-level atrium space covered with a barrel skylight. The building will present a space heating load of 6110 x 10^6 Btu/y for which the solar system will provide up to 50% of the energy required. A significant portion of the energy required for the building's domestic hot water heating will also be supplied by solar. At present, the possibility of using excess production for furnishing a hot water heating service to restaurants, retail shops, and a hotel in the surrounding development is being considered. This building is assumed to have a five-day week occupancy maintained at a temperature between 70° and 75°F. To reduce both the air conditioning and lighting costs, a limit of 3.5 $watts/ft^2$ has been set as an energy conservation goal for lighting and electrical equipment. The building is to be cooled by a variable air volume system with one 40,000-cfm air handler serving each zone. Chilled water is to be provided by two units; one to be sized on interior loads, the other will be sized for the fluctuating solar and ventilation loads. Recovered waste heat normally discharged through a cooling tower will be directed to a storage tank where it will be boosted by a high temperature heat pump to 170° for heating through perimeter fin-tube radiation. Heat pump outlet temperature will be reset according to outside air temperature. A 30° outlet temperature range is available. The solar array is comprised of 12,000 ft^2 of flat plate, low iron, single-glazed, selective surface solar collectors tilted 45°. Water storage will be provided by two 20,000-gal storage tanks connected in paralled.

5624 (DOE/CS/4131—1(Vol.3), pp 927-936) **Solar cooled industrial building at Canovanas, Puerto Rico.** Capacete; Martin. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design and cost analysis of the solar absorption air conditioning system and service hot water system for the 10,800 ft^2 production area and 1172 ft^2 equipment room are described. The system uses 7151 ft^2 of evacuated tube collectors, two 10,000 gal cold storage tanks, and one 3000 gal hot storage tank. The system is under construction; system cost is $547,131 not including engineering and administative expenses. (WHK)

5625 (DOE/CS/4131—1(Vol.3), pp 937-943) **Solar Demonstration Project, University of Rhode Island, College of Nursing, Kingston, Rhode Island.** Valis, T. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The new College of Nursing at the University of Rhode Island is a modern educational facility planned and equipped for all phases of teaching. The building contains 16 classrooms, 5 laboratories, 59 faculty and administrative offices, lounges, a lecture hall and a media center and a computer room, for a total of 41,872 ft^2. Generally, the building is a three-story structure with an additional ground floor on the south end where the natural grade of the terrain drops off. The solar energy system will accomplish approximately 35% of the annual space heating requirements and 100% of the water heating requirements. The system shall consist of approximately 5400 ft^2 of tracking collectors used to heat a 10,000-gal storage tank. The storage water is used to pre-heat the domestic and space heating water via water-to-water heat exchangers. Cooling is provided by a 148-ton absorption chiller. The system is in the final design stages with construction scheduled to begin April 1979; system estimated cost is $371,000.

5626 (DOE/CS/4131—1(Vol.3), pp 945-951) **Sullivans Island Elementary school solar heating and cooling demonstration project.** Clark, R.C.; Rast, G.B. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar heating and cooling system for 22,000 ft^2 of the 28,400 ft^2 building is described. It is planned to use 3700 ft^2 of evacuated tube collectors, a 5000 gal hot storage tank, a 5000 gal cold storage tank, and a 25-ton absorption chiller to provide 58% of the annual cooling load and 77% of the annual heating load. The system has not yet been submitted for bidding; cost estimates are given. (WHK)

5627 (DOE/CS/4131—1(Vol.3), pp 957-962) **Solar heating and cooling of Mount Rushmore National Memorial Visitor Center.** Chiang, C.W. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This project is a solar retrofit project of Mount Rushmore National Memorial Visitor Center at Keystone, SD, where over two million tourists visit each year. The Visitor Center has a total space of approximately 6000 ft^2. The solar system is designed to furnish approximately 45% of heating for the total facility, and approximately 53% partial cooling of the 2000 ft^2 observatory room. There are a total of 112 panels of Lennox liquid circulated collectors, each 3 ft x 6 ft in dimension, with a gross surface of approximately 2000 ft^2. The unit cost of the collector is about $13 per ft^2. Collector panels are mounted in 5 1/2 rows on the roof of the Visitor Center owned by National Park Service of the Department of Interior. Operation of the system since its completion in September 1977 is discussed.

5628 (DOE/CS/4131—1(Vol.3), pp 963-967) **Tennessee Building Materials Association solar energy system, Nashville, Tennessee.** Malloy, R.T. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar-assisted heat pump system for space heating and solar water heating system for the three-story building are described. The system will utilize 648 gross ft^2 of finned-tube flat plate collectors and a 1500 gal underground insulated steel storage tank. The project is out for bids to be accepted October 18, 1978; the expected solar system cost is $70,400. (WHK)

5629 (DOE/CS/4131—1(Vol.3), pp 969-970) **Coca-Cola Bottling Works of Jackson, Inc., solar hot water and space heating system, Jackson, Tennessee.** Williamson, B. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar space and process hot water system for the 70,000 ft² production building is briefly described. The system will utilize 9500 ft² of evacuated tube collectors and two 12,000 gal steel storage tanks to provide 50% of the space heating and process hot water load for the year. The system is not yet under construction. (WHK)

5630 (DOE/CS/4131—1(Vol.3), pp 977-981) **One Solar Place - Dallas' first solar heated office building.** Anderson, K.; Burgesser, B. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Design of the solar system under construction for the one-story 3100 ft² building with a two-story 7200 ft² addition is described. The system utilizes 1596 ft² of flat plate collectors and two 2300 gal reinforced concrete tanks. System start-up is scheduled for December 1978.

5631 (DOE/CS/4131—1(Vol.3), pp 987-995) **Demonstration project: North Hampton Park Recreation and Health Center.** Burgesser, B.; Orlowski, H. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned retrofit solar system for preheating 100% of the domestic hot water and supplying 47.5% of the annual building heating requirements for the 126,000 ft² school building is described. 5500 ft² of flat plate collectors and a 10,000 gal hot water storage tank will be used. It is anticipated that the project will be under contract sometime during January 1979 with completion estimated by May; total budget for the project is $322,588. (WHK)

5632 (DOE/CS/4131—1(Vol.3), pp 1001-1005) **DOD solar energy housing demonstration at Sheppard AFB, Texas.** Doskocil, J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Performance data for the period of January to August 1978 are given for the solar space and water heating systems for the four two-story quadruplex apartments. The solar systems utilized 840 gal storage tanks for space heating, 60 gal domestic water preheat tanks, and different flat plate collectors for comparison. Operational problems and performance monitoring problems are discussed. (WHK)

5633 (DOE/CS/4131—1(Vol.3), pp 1007-1012) **Operating experience: the Trinity University solar heating and cooling project.** Treat, C.H.; Clark, G. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The general design and operation of the retrofit solar space and water heating and air conditioning system for the central plant at Trinity University that serves 300,000 ft² of campus buildings are described. The system utilizes 16,080 ft² of Northrup tracking, concentrating collectors; 40,000 gal of hot water storage in two underground steel tanks; and a 350-ton Carrier lithium bromide absorption chiller. The system was completed in April 1977; but detailed evaluation of system performance is not yet possible due to instrumentation and data acquisition problems. (WHK)

5634 (DOE/CS/4131—1(Vol.3), pp 1013-1019) **Solar assisted water source heat pump, La Quinta Motor Inn, Salt Lake City, Utah.** Orlowski, H. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design, operation, and cost of the solar space and water heating system for the Motor Inn. The system utilizes 3204 ft² of flat plate collectors, a 2500 and a 7500 gal steel storage tank, and a solar-assisted water source heat pump. The system is in operation; total cost was $250,000. A solar system piping diagram is included. (WHK)

5635 (DOE/CS/4131—1(Vol.3), pp 1021-1024) **Solar heating and cooling system for the Rutland Group Building, Rutland, Vermont.** Beattie, M. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Rutland Group building is a combination office-warehouse facility for a design-build firm. The total building includes 4800 ft², 1969 ft² of which is solar heated office space. The warehouse is heated only sporadically with a ceiling-hung oil-fired furnace. The building is a pre-fabricated steel building 12' high at the eave, with a nearly flat roof. It is built on concrete perimeter walls extending four feet below grade to a frost-free level. Within this wall and under the floor slab is a horizontal flow rock bed. The building incorporates what have now become standard energy-saving techniques such as triple glazing; air lock entry; adequate insulation, including foundation insualtion and proper attention to siting to minimize wind impact while retaining maximum solar exposure. The solar collector occupies the entire south wall and roof of the heated space, leaving the east wall free for windows. This exposure allows a quick morning warm-up via passive direct gain. The solar space heating system was designed to provide about 3/4 of the office sections' space heating needs. The cooling season is short and intermittant in Rutland, Vermont and cooling of the rock bed with nocturnal air will provide adequte cooling for the building. The system is at the pre-startup stage. The total building cost $150,000; the solar portion was $30,000.

5636 (DOE/CS/4131—1(Vol.3), pp 1029-1034) **Renovation of Fauquier County High School solar heating system.** Liers, H.S.; McEver, W.S.; Harris, M.P.; Barbera, N.T. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This project consisted of renovations to a previous solar space heating system at Fauquier County High School in Warrenton, Virginia. The intention was to upgrade the system with collectors that have incorporated more recent technical advances. The system provides heat for five classrooms individually detached from the surrounding structures. A total of 4100 ft² of floor space is supplied with 77% of the heating requirements by solar energy. System operation, installation problems, and costs are discussed.

5637 (DOE/CS/4131—1(Vol.3), pp 1035-1041) **Performance of a solar assisted heat pump system for an office building.** Moseley, T.D. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The system is a 400 ft² (gross) drain down single glazed non selective flat plate collector with a 2000 gal storage tank. It was retrofitted into a 1780 ft² office building. A hot water duct coil supplies space heat when storage temperatures are above 90 to 95°F. Back up heat is provided by a gas boiler. Hot water is preheated before going to an electric water heater. The building has a design heat loss of 32,200 Btuh (net is 25,200 when considering internal loads and 0°F outdoor temperature) and is located in Lynchburg, Virginia, where 4160 degree days is normal for the average winter. System performance for the 1976-1977 and 1977-1978 winters is discussed.

5638 (DOE/CS/4131—1(Vol.3), pp 1043-1045) **Solar energy: a psychiatric hospital project.** Weinstein, M.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The planned solar space and water heating system for the one-story 26,928 ft² hospital is briefly described. The system will utilize 1644 ft² of flat plate liquid collectors, a 5000 gal storage tank, and a solar-assisted water-source heat pump. Construction of the system has not yet commenced; estimated construction cost is $84,000. (WHK)

5639 (DOE/CS/4131—1(Vol.3), pp 1047-1056) **Report on Project Sunburst: a Department of Energy commercial solar demonstration at Richland, Washington.** Ripley, C.C.; Poplin, R.S. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

A current Olympic Engineering Corporation project for the Department of Energy is the operation and demonstration of a solar space heating, space cooling, and domestic water heating system in our 14,4000 ft² Project Sunburst office building at Richland, Washington. The system is designed to provide 71% of the space heating, 97% of the space cooling, and most of the domestic water heating required for year around operation of the building. An array of 6000 ft² of roof-mounted ethylene-glycol/water cooled General Electric flat plate collectors supply energy through a heat exchanger to an underground insulated 9000 gal thermal energy storage tank. Hot water is pumped directly from TES to 8 water-to-air coils in the forced air duct work on demand by 8 zone thermostats in the winter. A 25 ton solar hot water driven Arkla absorption chiller cools water in a 2000 gal storage tank to supply cold water to the same water-to-air coils in the summer. Final acceptance testing of the solar system was completed in March 1978, and the 50 point DOE data acquisition system was installed in August and operational in September 1978. Comparing the energy consumption of Project Sunburst to an

identical non-solar building on the same site showed that 46,000 Kwh were saved in the first 6 months of solar operation.

5640 (DOE/CS/4131—1(Vol.3), pp 1057-1063) **Bethany College solar installation.** Barbera, N.J.; Liers, H.S. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The operating solar space and water heating system at the Leadership Conference Center at Bethany College is described. The system is designed to supply 44% of the heating load, 86% of the domestic hot water, and 79% of the combined load. 4512 gross ft^2 of flat plate collectors and a 6500 steel storage tank are incorporated. System operation and problems are discussed. Construction cost is estimated at $105,000 for materials plus 1400 hours of labor. (WHK)

5641 (DOE/CS/4131—1(Vol.3), pp 1065-1072) **Solar heating and cooling system for the Page Jackson Elementary School.** Spalding, M.A. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Design and operation of the solar space heating and air conditioning system for the 52,000 ft^2 school building are described. The system incorporates 11,215 ft^2 of flat plate, double glazed collectors with selective coating and two 10,000 gal steel storage tanks. Schematics of the solar system are included. (WHK)

5642 (DOE/CS/4131—1(Vol.3), pp 1073-1078) **Active solar heating system for warming hog farrowing building and drying vertically stored shelled corn in southwest Wisconsin.** Feyen, J.P. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This is an active space heating system that gathers heat from a 1200 ft^2 single cover curved plate collector which was retrofitted to an existing building. It is an integral part of the building though, as the original roof of the building has become the collecting plate. Located in southwest Wisconsin, where the annual temperature swing is from +100°F to -40°F, the system supplies fresh, dry, heated air to the hog farrowing building in an open loop ventilation system that requires at least four complete exchanges of air per hour. A second function of the collector is to provide the heat necessary for low-temperature drying of 4800 bushels of shelled corn by reducing kernel moisture from an average 25% down to 14-15% for long term storage. The heat, then, is used in two operations at two different locations. The system must supply heat to offset approximately 9000° heating days for the hog operation, and must provide a 6° temperature rise in the 4800 bu of corn throughout October and November for drying purposes.

5643 (DOE/CS/4131—1(Vol.3), pp 1079-1086) **Lakeshore Technical Institute solar heated Equine Management Training Center.** Groth, G. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Plans for the solar space and water heating system with supplementary anerobic digestor heating are briefly described. The center includes 4560 ft^2 for judging/classroom, office, laboratory, etc. The solar system will utilize 735 net ft^2 of flat plate air-type collectors and a 27-ton rock bed heat storge bin. (WHK)

5644 (DOE/CS/4131—1(Vol.3), pp 1087-1088) **Passive solar office building in Laramie, Wyoming.** Barker, J.W. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

A passive solar building with office and workshop space for which the predicted solar contribution for space heating exceeds 90% in an 8750° day climate has been designed. Hollow precast concrete slabs filled with water serve as walls, as thermal storage, and as the thermal distribution network. The design philosophy and operation are discussed.

5645 (DOE/CS/4131—1(Vol.3), pp 845-847) **Outerbridge Crossing Toll Plaza solar heating and cooling.** Horowitz, F. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar heating and air conditioning system for the seven toll booths which are 40 ft^2 each is described. The system employs 1692 ft^2 of General Electric Company TC-100 solar collectors, two 1250 gal thermal storge tanks, and a 25-ton Arkla absorption chiller. Operation and control are disussed. (WHK)

5646 (NMEI—16) **Economical solar heated and cooled residence for southern New Mexico. Final report.** Mancini, T.R.; Smith, P.R. (New Mexico State Univ., Las Cruces (USA). Dept. of Mechanical Engineering). Jul 1979. 55p. New Mexico Energy Inst., New Mexico State University, Las Cruces, NM.

The objectives of this project are to build and evaluate the performance of SKYTHERM solar heated and cooled passive house located on the campus of New Mexico State University in Las Cruces, New Mexico. Of primary importance to the study is the evaluation of capabilities of the system in a severe cooling climate such as encountered in Las Cruces. In a SKYTHERM house a large mass of water contaned in clear plastic bags is located on the roof beneath movable insulating panels. During the winter heating mode of operation, the panels are removed during the day, permitting the sun's energy to heat the water, and replaced to insulate the water pond at night. Day and night the warm water on the roof heats the house by heat transfer through the ceiling. When the system is in the summer cooling mode of operation, the cycle is reversed with the insulating panels in place over the water bags during the day and removed at night. In this summer the heat absorbed from the house during the daylight hours is rejected to the clear night sky by radiaion and convection heat transfer. The design and construction of the house and the solar system are described, and some preliminary heating and cooling data are presented and discussed. (WHK)

5647 (NP—24023) **IGT research experience in solar energy.** (Institute of Gas Technology, Chicago, IL (USA)). Aug 1979. 12p. Institute of Gas Technology, 3424 S. State Street, Chicago, IL 60616.

The areas of solar energy research by the Institute of Gas Technology are reviewed. Research is briefly reviewed in the following areas: solar thermal radiation, solar total energy systems, solar energy applications, residential energy load analysis, air-cooled absorption, absorption cooling fluids, adsorption heating and cooling, heat pump systems, solar thermochemical hydrogen production, low-temperatre hydrogen production cycles, molten salt energy storage systems, reversible chemical reaction energy storage systems, OTEC energy transmission, wind power, hydrogen distribution, biomass conversion, and photosynthetic hydrogen production. (WHK)

5648 (PB—289967) **Interim performance criteria for solar heating and cooling systems in residential buildings (Second Edition). Final report.** Holton, J.K. (National Bureau of Standards, Washington, DC (USA). Building Economics and Regulatory Technology Div.). Nov 1978. 113p. NTIS PC A06/MF A01.

The interim performance criteria, developed for the Department of Housing and Urban Development, are criteria and standards for the design, development, technical evaluation and procurement of the solar heating and cooling systems to be used in residential buildings during the solar heating and cooling demonstration program authorized by the Solar Heating and Cooling Demonstration Act of 1974. These interim criteria are intended primarily for use in the solar residential demonstration program and as a basis for the preparation of definitive performance criteria.

5649 (PB—290378) **Swedish central solar heating plant for 2000 dwellings; a feasibility study.** Margen, P.; Perers, B.; Spangberg, K. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). 1978. 28p. NTIS PC A03/MF A01.

Sweden is giving considerable attention to the concept of collecting and storing solar heat at a central site, for distribution to groups of houses and flats. The concept will be demonstrated first by a plant built at Studsvik due for commissioning during 1978. This consists of an insulated excavated pit filled with hot water. It is covered by an insulation lid on which concentrating solar collectors are mounted. The insulation lid can be swivelled horizontally to enable the collectors to track the sun. This demonstration plant will supply all the heating needed for an associated office building, all the year round. Two larger versions of solar heating plants for schemes with about 50 houses each have been decided on at Lambohov and Ingelstad. The Lambohov plant is based on hot water stored in an insulated pit excavated in rock and can be regarded in several aspects as a follow-up of the Studsvik project. It is fitted with heat pumps to recover residual low temperature heat from the store. The Ingelstad plant will use a concrete hot water storage tank above ground and separately mounted concentrating solar collectors.

5650 **Assist of an air-to-air heat pump using solar heated hot water.** Drake, M.S. Lawrence, KS; Univ. of Kansas (1979). 110p. University Microfilms Order No. 79-25,871.

Thesis (Ph. D.).

This study investigated an arrangement using an air-to-air heat pump of the type usually installed in residences. A split unitary heat pump was used with duct and outlets installed to approximate an actual installation. A 55 gallon drum fitted with an electric immersion heater simulated a solar heated water storage tank. Circuit piping led from the storage tank to a hot water coil located ahead of the outdoor refrigerant coil. Since the liquid in the circuit and coil was subjected to freezing temperatures, it was necessary to employ an anti-freeze solution. Liquid temperatures in the range of 60°F to 95°F were used with ambient conditions of 0°F to 45°F.

Two different preheat coils and two propeller-motor combinations were investigated. The results indicated that a hot water solar system could be incorporated with an air-to-air heat pump and improve the utility of both systems. (MOW)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 5515, 5629, 5642

5651 (SERI/TP—333-427) **Two case studies of the application of solar energy for industrial process heat.** Hooker, D.W.; West, R.E. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 8p. (CONF-791024—7). Dep. NTIS, PC A02/MF A01.

From Solar industrial process heat conference; San Francisco, CA, USA (31 Oct 1979).

Case studies of industrial process heat (IPH) have been performed by the Solar Energy Research Institute (SERI) on selected plants in metal processing, oil production, beverage container manufacturing, commercial laundering, paint (resin manufacturing), and food industries. For each plant, the application of solar energy to processes requiring hot water, hot air, or steam was examined, after energy conservation measures were included. A life-cycle economic analysis was performed for the solar system compared to the conventional energy system. The studies of the oil production facility (oil/water separation process) indicate that it could economically employ a solar hot water system immediately. The studies of solar energy applied to the beverage container process (solar air preheat system with partial recycle of oven exhaust gases) indicate a 7.5-yr payback period, based on a solar system installation in 1985.

WATER HEATING

REFER ALSO TO CITATION(S) 5515, 5516, 5546, 5547, 5548, 5549, 5550, 5551, 5553, 5557, 5561, 5563, 5564, 5566, 5567, 5568, 5569, 5570, 5571, 5573, 5574, 5575, 5577, 5580, 5582, 5584, 5586, 5587, 5591, 5592, 5593, 5594, 5595, 5600, 5601, 5602, 5603, 5604, 5605, 5606, 5607, 5608, 5610, 5613, 5614, 5615, 5616, 5618, 5622, 5623, 5624, 5625, 5628, 5630, 5631, 5632, 5633, 5634, 5637, 5638, 5639, 5640, 5643

5652 (DOE/CS/4131—1(Vol.3), pp 433-442) **Solar hot water demonstration project (industrial laundry).** Burnett, E.S. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

This project was designed and implemented as a total conservation system to preheat incoming city water for use in the Red Star Industrial Service Laundry in Fresno, California. Comprising two (2) major subsystems - a waste-water heat recovery subsystem and a flat-plate solar collector subsystem with independent storage - the total system was designed to reduce fossil fuel consumption for hot water supply to the laundry by 50%. Without the system, fossil fuel demand for hot water was estimated to be 104,000 ft^3 of natural gas per year, based on supplying 34,000 gpd of hot water at a temperature of 180°F. This demand has actually been reduced to less than 60,000 ft^3 per year by the system with a potential further reduction below 52,000 ft^3 per year. Annual savings attributable to the wastewater heat recovery subsystem and the solar subsystem, at current natural gas prices of $2.30/Mcf, are $8000 and $2300 respectively. Applying the escalations in natural gas prices projected by Pacific Gas and Elecric Company through 1988 to a life-cycle cost analysis gives an estimated payback period of 8 years for the total system, but a solar subsystem payback in excess of 15 years. The wastewater heat recovery subsystem was supplied by Heat Recovery Systems, Inc., Paramount, California, who also participated in the overall system design. A total of 140 single-glazed flat-plate liquid collectors with a nominal area of 6500 ft^2 and 12,500 gal fiberglass storage tank were supplied by Ying Manufacturing Corp., Gardena, California. Design and installation was a joint venture of Ying Manufacturing Corp. and Clarke Mechanical, Inc., Long Beach, California, assisted by heat Recovery Systems, Inc. under the direction of the author as project manager.

5653 (DOE/CS/4131—1(Vol.3), pp 473-478) **Performance of the SAGE System at El Toro.** Rice, J.F.; Bartera, R.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The El Toro system provides solar-heated domestic hot water for two buildings. There are 32 apartment units in the two buildings with an occupancy of 60 people. For the system design, it was assumed that the daily demand for hot water was 20 gal/d-person or a total of 1200 gal/d. With an average temperature rise of 80°F, the energy required for this load is 292 MMBtu/y. The solar heating system was sized to provide 66% of the required heat, on an annual average, or 192 MMBtu/y. 1008 ft^2 of flat plate collectors and a 1280 gal storage tank were used. The measured performance for a period of one year is presented.

5654 (DOE/CS/4131—1(Vol.3), pp 595-598) **Ramada Inn solar water heating project, Honolulu, Hawaii.** Pressler, T.E. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The Ramada Inn Solar Heating Project consists of 3600 ft^2 net aperture area of flat plate collectors mounted on the roof of an existing 210 room hotel building. Existing gas-fired water heaters will remain in operation for standby hot water should the solar system hot water temperature drop below the hot water heater set point. The existing roof will also be utilized for a 4250 gal solar hot water storage tank. Project completion is scheduled for the spring of 1979.

5655 (DOE/CS/4131—1(Vol.3), pp 811-817) **Solar hot water system for the Coachlight Motel in Las Cruces, New Mexico.** Cooper, T.J. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Inspection and testing of the retrofit solar hot water system for the 108 unit motel, pool, and restaurant was completed on June 7, 1978. 1075 ft^2 of evacuated flat plate collectors and three 350 gal water storage tanks are used. Total installation cost was $57,582. The design, performance, and problems encountered are discussed. (WHK)

5656 (DOE/CS/4131—1(Vol.3), pp 953-956) **Days Inns of America, Inc. solar hot water system, Anderson, South Carolina.** Coley, M.Q. Jr. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The design and operation of the retrofit solar water heating system for the two-story 114-room motel are described. 750 ft^2 of flat plate collectors are used with a 1000 gal fiberglass storage tank to provide approximately 40% of the total demand. The system has performed flawlessly since it was put in operation in November 1977. The toatl installed cost was $27,300. (WHK)

5657 (DOE/CS/4131—1(Vol.3), pp 997-1000) **Solar domestic water heating system, La Quinta Motor Inn, Texas City, Texas.** Davis, W.B. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

Design and operation of the solar water heating system installed at the motor inn are described. 2000 gross ft^2 of flat plate collectors and a 2500 gal steel tank are incorporated. Performance data have not yet been taken. Total cost of the project was $83,376. (WHK)

5658 (DOE/CS/4131—1(Vol.3), pp 1025-1027) **Charles S. Monroe Vocational Technical Center domestic hot water system, Loudoun County, Virginia.** Bridges, L.B. Jul 1979.

From Second solar heating and cooling commercial demonstration program contractor's review; San Diego, CA, USA (13 Dec 1978).

The solar water heating system which was designed to provide 1800 gal water/day at 120°F was put into operation in May 1978. The system utilizes 1225 ft^2 of flat plate collectors and a 2000 gal and a 1000 gal hot water tank. System operation and performance are briefly discussed. The cost of the system, not including installation of the monitoring sensors or the visual display/demonstration panel was $70,420. (WHK)

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 5531, 5532, 5533, 5534, 5544, 5987

5659 **Solar steam generator.** Ferriera, C.R. US Patent 4,154,224. 15 May 1979. Filed date 18 Mar 1977. 4p.

The present invention is an improvement in variable vacuum steam heating systems and subatmospheric steam heating systems consisting of a solar energy collecting panel capable of performing as full or part time substitute for the conventional steam boilers of vacuum steam heating systems. Essentially, the collector is two semi rigid air tight panels laminated together to provide a thin air tight chamber between their inner surfaces in which condensate being returned to the collector from the usual steam radiators, convectors, blast coils, and other heating devices is changed into steam at temperatures up to 212°F under subatmospheric pressures by solar radiation. The collector panel is intended for roof or pad mounting in a semi-upright position and being piped into certain vacuum steam

heating systems in a manner which allows the collector to remain in stand by or to work in parallel with the conventional boiler as a steam producer or to perform as full substitute for the conventional steam boiler automatically in accordance with prevailing weather conditions and the availability of solar radiation.

HEAT STORAGE

REFER ALSO TO CITATION(S) 5534, 5647, 5797

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

USA

5660 (DOE/SF/01049—T1) **Geothermal energy in Washington: site data base and development status.** Bloomquist, R.G. (Washington Div. of Geology and Earth Resources, Olympia (USA); Washington State Energy Office, Olympia (USA)). Apr 1979. Contract EY-77-C-06-1049. 207p. Dep. NTIS, PC A10/MF A01.

This is an attempt to identify the factors which have affected and will continue to affect geothermal assessment and development in the state. The eight potential sites chosen for detailed analysis include: Indian Heaven KGRA, Mount St. Helens KGRA, Kennedy Hot Springs KGRA, Mount Adams PGRA (Potential Geothermal Resource Area), Mount Rainier PGRA, Mount Baker PGRA, Olympic-Sol Duc Hot Springs, and Yakima. The following information is included for each site: site data, site location and physical description, geological/geophysical description, reservoir characteristics, land ownership and leasing, geothermal development status, institutional characteristics, environmental factors, transportation and utilities, and population. A number of serious impediments to geothermal development were identified which can be solved only by legislative action at the state or federal level and/or changes in attitudes by regulatory agencies. (MHR)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 5349

GEOPHYSICAL TECHNIQUES AND SURVEYS

5661 (ALO—3721-T1) **Terrestrial heat-flow studies in Arizona. Progress report.** Shearer, C.R. (New Mexico Inst. of Mining and Technology, Socorro (USA)). Oct 1979. Contract EY-76-S-04-3721. 191p. Dep. NTIS, PC A09/MF A01.

New heat-flow data in Arizona suggest that the southern Basin and Range has perhaps recently undergone less extension than other areas of the Basin and Range province. The role of groundwater movement as a major factor in the variation of heat-flow data in the Arizona Basin and Range is demonstrated at two locations where an increase of the surface heat-flow by a factor of 2 or more over a lateral distance of several tens of km is attributed to groundwater circulation. Heat flow-heat production data suggest that crustal and upper mantle magmatic and thermal sources, such as are reported beneath the Rio Grande rift, are much less abundant in the crust and upper mantle beneath southern Arizona and northwestern Mexico. A heat-flow transition between the Basin and Range and the Colorado Plateau occurs within a lateral distance of 80 km in Arizona where predicted steady-state temperatures indicate that the M-discontinuity is nearly coincident with an isotherm. The deep new heat-flow data suggest that the mean value for the Arizona Basin and Range is 1.9 to 2.0 HFU, indicating that there may be as little as 0.3 HFU difference between the Colorado Plateau and the Arizona Basin and Range. This difference could be due primarily to magmatic intrusion in the Arizona Basin and Range.

5662 (COO—2534-5) **Seismological investigation of crack formation in hydraulic rock fracturing experiments and in natural geothermal environments. Progress report, September 1, 1978-August 31, 1979.** Aki, K. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1979. Contract EY-76-S-02-2534. 69p. Dep. NTIS, PC A04/MF A01.

An interpretation theory based on the fluid-filled crack model of geothermal systems is being developed and tested against a variety of data from various geothermal areas. Progress is reported on the following subjects: (1) analysis and interpretation of seismic data obtained from the bore holes at the LASL Hot Dry Rock geothermal site. (2) Collection, analysis and interpretation of data on deep volcanic tremors at the USGS Hawaii Volcano Observatory. (3) Development of a new method for determining seismic attenuation at frequencies higher than 1HZ, and initiation of a cooperative work with Mexican seismologists on the attenuation measurements at various geothermal areas in Baja, California using the method. (4) Installation of 3-component digital event-recorders at four stations in the Newberry Peak volcano, Oregon. (5) Developing a computer program for calculating seismic motion generated by the vibration of fluid-filled crack in a layered medium.

5663 **Heat flow of Oregon.** Blackwell, D.D.; Hull, D.A.; Bowen, R.G.; Steele, J.L. Portland, OR; Oregon Department of Geology and Mineral Industries (1978). 46p. (NP—24014).

An extensive new heat flow and geothermal gradient data set for the State of Oregon is presented on a contour map of heat flow at a scale of 1:1,000,000 and is summarized in several figures and tables. The 1:1,000,000 scale heat flow map is contoured at 20 mW/m^2 (0.5 HFU) intervals. Also presented are maps of heat flow and temperature at a depth of 1 km averaged for 1° x 1° intervals. Histograms and averages of geothermal gradient and heat flow for the State of Oregon and for the various physiographic provinces within Oregon are also included. The unweighted mean flow for Oregon is 81.3 +- 2.7 mW/m^2 (1.94 +- 0.06 HFU). The average unweighted geothermal gradient is 65.3 +- 2.5°C/km. The average heat flow value weighted on the basis of geographic area is 68 +- 5 mW/m^2 (1.63 +- 0.12 HFU) and the average weighted geothermal gradient is 55.0 +- 5°C/km.

EXPLORATORY DRILLING AND WELL LOGGING

5664 (NE-PROJ—4560-062) **Drilling and test pumping of Hoellviksnaes. I. Results of drilling and capacity testing.** (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). Sep 1978. 57p. (In Swedish). Dep. NTIS (US Sales Only), PC A04/MF A01.

An account is given of the drilling work performed at Hoellviksnaes, Sweden. This drilling is part of a project to study possibilities to exploit geothermal energy in Skaane, Sweden, in the future.

LEGAL AND INSTITUTIONAL ASPECTS

5665 **Department of Water Resources' notice of intention to file an application for certification of DWR Bottle Rock. Final report.** Sacramento, CA; California Energy Commission (1979). 217p. (NP—24051).

Preliminary findings and conclusions are presented on the following: conformity to the forecast of statewide and service area electric power demands; conformity of the proposed site and related facilities with applicable local, regional, state, and federal standards, ordinances, and laws, including any long-range land use plans or guidelines adopted by the state or by any local or regional planning agency; the safety and reliability of the facility; and the relative merit of any alternative site and related facility proposed in the notice or in sufficient detail at the hearings. A Proposed Decision, approving the Notice, with conditions for consideration by the full commission is included. A description of the proposed project; a summary of the proceedings to date, comments from the general public, and government agency comments on the Preliminary Report are given. The comments of the applicant and the Commission staff regarding the Preliminary Report and the Committee's view of those issues that require further consideration are included. (MHR)

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 5665

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 5666

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 5662

DIRECT ENERGY UTILIZATION

5666 (DOE/ID/01707—14) **Western South Dakota usage of geothermal energy from the Madison formation.** Iszler, J.; Carda, D.; Skillman, D.; Dunham, G.; Reuter, W. (Edgemont School District, SD (USA)). Jan 1979. Contract ET-78-S-07-1707. 161p. Dep. NTIS, PC A08/MF A01.

Complete water analyses were performed on existing Madison wells, shallower wells, and surface waters. Corrosion testing

included measurements in standard weight loss, stress corrosion, and electro chemical analysis to determine suitable alloys for the project. Low-pressure steam, heat pumps, and direct heating alternatives were analyzed and compared. All buildings were modeled on a digital computer to determine heat gains and losses and the sensitivity of the net annual heat loss to changes in various building and operating parameters. Parameters with the highest sensitivities were further analyzed to determine the optimum cost-benefit ratio and the optimum net present worth of proposed changes. Finally, a control scheme was conceptually designed for monitoring and controlling a geothermal heating system.

WIND ENERGY

REFER ALSO TO CITATION(S) 5516

5667 (PB—289606) **Wind engineering Research Council (WERC) Newsletter. Volume 2.** Parmelee, R.A. (Wind Engineering Research Council (USA)). Dec 1977. 58p. NTIS PC A04/MF A01.

The third issue of the WERC (Wind Engineering Research Council) Newsletter marks the resumption of its publication since August 1975. Its effectiveness is dependent upon interactions with the reader in the form of news items, meetings, etc. The newsletter is divided into sections on WERC news, wind engineering research, proceedings available, conferences and seminars, and publications and announcements. In an introductory article, the chairman of WERC comments on council activities from 1975 and plans for future activities in the field of wind engineering research. A blank form is enclosed for sending information on research projects. Included are a paper on buildings and structures presented at the Canadian Workshop on Wind Engineering in Toronto; outlines of proceedings of the Fourth International Conference on Wind Effects on Buildings and Structures at Heathrow, Great Britain; the Second USA-Japan Research Seminar on Wind Effects on Structure held in Kyoto; a workshop on wind load requirements for buildings; and a symposium on tornadoes. The section on publications consists of abstracts of literature in the field of wind engineering.

5668 (SERI/SP—69-290) **Wind energy information directory.** (Solar Energy Research Inst., Golden, CO (USA)). Oct 1979. Contract EG-77-C-01-4042. 30p. Dep. NTIS, PC A03/MF A01.

Wind Energy Information has been prepared to provide researchers, designers, manufacturers, distributors, dealers, and users of wind energy conversion systems with easy access to technical information. This directory lists organizations and publications which have the main objective of promoting the use of wind energy conversion systems, some organizations that can respond to requests for information on wind energy or make referrals to other sources of information, and some publications that occasionally include information on wind energy. The bibliography contains references to information for both the neophyte and the expert.

ELECTRIC POWER ENGINEERING

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 5868

5669 **Combined compressed air storage-low Btu coal gasification power plant.** Kartsounes, G.T.; Sather, N.F. (to Dept. of Energy). US Patent 4,158,145. 12 Jun 1979. Filed date 20 Oct 1977. 8p. PAT-APPL-844,084.

The electrical generating power plant includes a Compressed Air Energy Storage System (CAES) fueled with low Btu coal gas generated in a continuously operating high pressure coal gasifier system. This system is used in coordination with a continuously operating main power generating plant to store excess power generated during off-peak hours from the power generating plant, and to return the stored energy as peak power to the power generating plant when needed. The excess coal gas which is produced by the coal gasifier during off-peak hours is stored in a coal gas reservoir. During peak hours the stored gas is combined with the output of the coal gasifier to fuel the gas turbines and ultimately supply electrical power to the base power plant.

5670 (PB—292798) **Simple models for computing dynamic responses of complex frame structures.** Chen, C.C.; Sun, C.T.; Bogdanoff, J.L., Lo, H. (Purdue Univ., Lafayette, IN (USA). School of Aeronautics and Astronautics). Apr 1978. 96p. NTIS, PC AA05/MF A01.

Prohibitive costs of analyzing large frame structures using the finite element method have led researchers to investigate simpler procedures of analysis. The development of a simple shear beam and a Timoshenko base model for dynamic analysis of complex frame structures is described. Formulas are derived for computing the equivalent shear and bending rigidities of the structure. Simple models are evaluated by comparing simple model solutions with solutions obtained from using full scale finite elements in free vibrations of plane frames. It was found that the simple models yield very accurate frequencies as well as mode shapes for the lower modes, and the Timoshenko model is more superior to the shear beam model when diagonal bracings are present. When the shear beam model was employed to compute the natural frequencies of a TVA fossil fuel power plant at Paradise, Kentucky, the first two frequencies were found to be in good agreement with the finite element solutions. The simple models were also used to compute transient dynamic responses of structures subjected to earthquake disturbances. Evaluative examples and dynamic internal force and moment computations using simple models are included.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 5318

5671 (K/CSD—11) **Cooling tower recirculation as influenced by the local atmospheric flow field, a numerical study.** Becker, B.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1979. Contract W-7405-ENG-26. 208p. Dep. NTIS, PC A10/MF A01.

Thesis.

A survey of the literature shows that existing methods of numerically modeling cooling tower plume recirculation ignore the aerodynamic effects of the atmospheric flow over the cooling tower. This investigation describes a method of numerically modeling cooling tower plume recirculation which is unique in two respects. First, the structure of the wake region behind the tower is resolved using the two-dimensional turbulent Navier-Stokes equations. Second, the flow field within the cooling tower is modeled as flow through porous media. This interior flow field is then coupled to the atmospheric flow over the tower by matching both pressures and mass flow rates at the cooling tower louvers. The atmospheric flow over a cooling tower is approximated by a two-dimensional flow field in terms of stream function and vorticity transport equations with the Boussinesq approximation used to account for buoyancy effects. The turbulence effects are modeled using a turbulent viscosity based upon the turbulence kinetic energy and turbulence length scale, both of which are calculated from transpot equations. A transport equation is also used to determine the temperature distribution in the wake region from which the plume profile and recirculation can be determined. The flow field within the cooling tower is calculated as a Darcy flow through porous media. This calculation yields the pressure distribution within the tower. Calculations made with the model are presented. These calculations agree reasonably well with laboratory and field measurements reported in the literature.

WASTE-FUELED SYSTEMS

5672 (PB—291043) **Resource recovery facility pre-feasibility study: municipal electric light plant, City of Hagerstown, Maryland. Final report, March-August 1978.** Shea, J.E.; Sheahan, R.L.; Higgins, B.P.J. (Henningson, Durham and Richardson, Chevy Chase, MD (USA)). Dec 1978. Contract ARC-77-123/MD-5634. 223p. NTIS PC A10/MF A01.

This report presents the results of a study to determine the feasibility of energy and materials recovery from solid waste for the City of Hagerstown, Maryland, and surrounding Washington County (1978 population: 110,000). The study included: projections of solid waste quantity, composition, and combustion characteristics; a survey of markets for recoverable electrical energy, steam, and secondary materials; and an analysis of current solid waste management practices for application in a strategy of resource recovery. Based on solid waste projections and on existing facilities at the City-owned Municipal Electric Light Plant, a resource recovery system was selected for conceptual design and cost analysis. This system included: a refuse derived fuel (RDF) processing plant; a storage bin; and a boiler modified to burn RDF with coal and produce steam for electrical energy generation. Annual costs were projected from 1982, the proposed first year of operation, through the year 2000, based on capital and operating costs, financing arrangements, and potential savings and revenues. (Color illustrations reproduced in black and white)

COMPONENTS

REFER ALSO TO CITATION(S) 5227, 5243, 5280, 5335, 5336, 5953, 5955, 5999, 6001

5673 (CONF-791014—, pp 61-89) **Materials design requirements for structural ceramics in turbines and heat exchangers.** Coombs, M.G.; Kotchick, D.M. 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

Ceramic components can be incorporated into advanced turbine and heat exchangers with careful materials selection and the measurement of important basic materials properties. Because strength data on ceramic materials vary widely, the statistical approach is the key for relating the basic materials strength data to the actual component designs and reliability models. Both design and the material properties in the as-fabricated components should be tested. This may involve a combination of proof testing, non-destructive inspection techniques, or destructive component tests. With these techniques, it is possible to successfully design, fabricate, and test complex ceramic structures like the ceramic heat exchangers and high-temperature turbine components discussed in this paper.

5674 (CONF-791014—, pp K.95-K.110) **Materials development for heat exchangers and turbines.** Stringer, J. (Electric Power Research Inst., Palo Alto, CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

It is clear that the use of heat exchangers and gas turbines with direct coal combustion presents a number of problems. A number of corrosive situations can arise, essentially of two types. The first is the high-temperature corrosion induced by molten salt layers rich in alkali metal sulfates in the presence of relatively high SO_3 partial pressures. This produces acid fluxing of the normally protective oxide, and several mechanisms exist which result in the dissolved metal being reprecipitated as a loose, porous, nonprotective oxide in the outer parts of the molten salt layer. The second form of corrosion is sulfidation/oxidation, which occurs when the oxygen activity is low in the presence of a sulfur source such as FeS or $CaSO_4$. Because coal contains ash, the combustion products contain particulates, and these can result in erosion of metallic components. The remedies are to remove the particles, reduce the gas velocity, or improve the materials. While the selection and design of materials resistant to the erosive and corrosive environments is plainly very important, many of the problems can be reduced or eliminated by appropriate changes in design or operational procedure. It is important to concentrate the material research in areas where no alternative fix is available, or where it would be unacceptable on economic or practical grounds. Improved materials may, however, not eliminate the need for a design or operational change, but they may make it easier to attain at a reasonable cost. The interaction of the materials problems with the system characteristics must always be borne in mind.

5675 (CONF-791014—, pp II.58-II.62) **Evaluation of hot corrosion resistance of candidate ceramic coatings for industrial/utility gas turbines.** Barkalow, R.H.; Pettit, F.S. (Pratt & Whitney Aircraft, Middletown, CN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5676 (CONF-791014—, pp III.73-III77) **Elimination of impurity-induced embrittlement of steels.** McMahon, C.J. Jr.; Pope, D.P.; Graham, W.R. (Univ. of Pennsylvania, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5677 (CONF-791014—, pp V.12-V.16) **Fireside corrosion. Task III: boiler tube materials for advanced power cycles.** Plumley, A.L. (Combustion Engineering, Inc., Windsor, CT). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5678 (CONF-791014—, pp V.17-V.21) **RP-644 design of improved materials systems for coal-fired boiler superheater and reheater tubes.** Rehn, I.M. (Foster Wheeler Development Corp., Livingston, NJ). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5679 (CONF-791014—, pp V.34-V.39) **Materials and process development for the water-cooled gas turbine high temperature turbine technology program.** Schilling, W.F. (General Electric Co., Schenectady, NY). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5680 (CONF-791014—, pp V.40-V.41) **Potential use of modified 9 Cr-1 Mo steel for fossil utility boiler applications.** Sikka, V.K. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5681 (CONF-791014—, pp V.67-V.68) **Erosion study in turbomachinery affected by coal and ash particles.** Tabakoff, W.; Hamed, A. (Univ. of Cincinnati, OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5682 (CONF-791014—, pp V.75-V.76) **Improvement of metallic coatings for gas turbine airfoils.** Beale, H.A. (Battelle Columbus Labs., OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5683 (CONF-791014—, pp VI.1-VI.9) **Technology for ceramic tube heat exchangers.** Ward, M.E.; Gulden, M.E.; Metcalfe, A.G. (International Harvester Co., San Diego, CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5684 (CONF-791014—, pp VI.18-VI.23) **High temperature ceramic heat exchanger.** Coombs, M.G.; Kotchick, D.M. (AiResearch Manufacturing Co., Terrance, CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5685 (CONF-791014—, pp VI.27) **Technology assessment of ceramic joining applicable to heat exchangers.** Brassell, G.W.; Tennery, V.J. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5686 (CONF-791014—, pp VI.33-VI.36) **Thermal barrier coatings for heavy oil gas turbines.** Levine, S.R. (Lewis Research Center, Cleveland, OH). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5687 (CONF-791014—, pp VI.38-VI.39) **Ceramic coatings for turbines.** Becher, P.F. (Naval Research Lab., Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5688 (EPRI-NP—1211) **Simulation of a U-tube steam generator with COBRA-IV and COBRA-TF. Interim report.** Stewart, C.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 53p. Dep. NTIS, PC A04/MF A01.

The results of thermal-hydraulic simulations of a Combustion Engineering System 80 U-tube steam generator are presented. Both steady-state and transient conditions are considered to compare the results of the Battelle COBRA-IV homogeneous-equilibrium code and a newly developed two-fluid (UVUT) two-phase flow model called COBRA-TF (EPRI). The details of formulating the code input to simulate the primary and secondary flows are discussed. All results presented here must be considered as only a demonstration and not as actual steam generator behavior.

5689 (FE—2455-27(Vol.2)) **Conceptual design of an AFBC electric power generating plant. Final report, Volume II: program description.** Kimel, E.; Panico, S.; Bianchini, J.; Novack, M.; Armstrong, J.; Wysocki, J. (Burns and Roe, Inc., Woodbury, NY (USA)). Feb 1979. Contract EF-77-C-01-2455. 335p. Dep. NTIS, PC A15/MF A01.

The US Department of Energy (DOE) awarded a contract to Burns and Roe, Inc., in January 1977 for the Conceptual Design of an Atmospheric Fluidized-Bed Combustion (AFBC) Electric Power Generating Plant. The results of an Interim Report, issued in March 1978, indicate that fluidized-bed technology, as presently developed, offers a potential near term solution to the problems associated with the use of noncompliance coals that may be economically attractive to the electric power utilities. Its successful implementation, thus, has great potential economic benefits to the industry as well as the strategic interests of the country in reducing the dependence on petroleum products. Based on the findings presented in the Interim Report, DOE authorized Burns and Roe to proceed with further detailed investigations in a number of areas. This Final Report presents the results of this two-year program. It includes information on coal and limestone pretreatment, sulfur capture by coal ash, AFBC boiler design, economic analysis, and spent material handling system.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 5937, 5939

ECONOMICS

REFER ALSO TO CITATION(S) 5735, 5739, 5740, 5866

5690 (EPRI-WS—78-94(Vol.1), pp 8.1-8.11) **Homer City Station Unit 1 internal inspection, Spring 1978.** Bradish, T. Jr.; McKinney, S.G.; Wise, R.L. (Pennsylvania Electric Co., Johnstown). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

This paper discusses the scheduled 14-week internal inspection of Homer City Station Unit 1. The minemonth station consists of three coal-fired units located in western Pennsylvania. Maintenance planning requires the coordination of manpower and materials. Power station management, when faced with an outage end date, a predetermined dollar budget that must not be exceeded, limited labor resources, and a seemingly endless list of high-priority tasks to perform, has some tough decisions to make. The whole process provides tremendous incentive to do better planning next time. 1 figure. 2 tables.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 5792, 5793

FUELS

REFER ALSO TO CITATION(S) 5344, 5891

5691 (EPRI-AF—1182) **Economics of retrofitting power plants for coal-derived medium-Btu gas. Final report.** (Bechtel National, Inc., San Francisco, CA (USA)). Oct 1979. 128p. Dep. NTIS, PC A07/MF A01.

Capital and operating cost estimates have been prepared for over-the-fence retrofitting of existing 500 MWe power plants to burn medium-Btu gas derived from developmental-stage, second-generation, oxygen-blown coal gasification processes. The economics of the retrofit installations, including the complete gasification system costs, have been compared to those of a reference power plant defined as a new, gas-roots, conventional coal-fired boiler facility equipped with flue gas desulfurization. The two types of power plants selected for retrofit are representative of relatively new (1) natural-gas-fired boiler plants and (2) oil-fired combined-cycle units. The reference power plant contains two 500 MWe coal-fired units typical of current new installations. The two oxygen-blown coal gasification systems evaluated for each retrofit were the Texaco process and the Combustion Engineering process. Neither of these gasification processes has been demonstrated at the commercial scale used in this study. Each coal gasification system was treated as a completely separate, self-contained facility supplying medium-Btu fuel gas to an adjacent existing power plant. With coal priced at $1 per million Btu, busbar power costs ranged from 37.6 to 42.3 mills per kilowatt-hour for the retrofit plants and were 38.5 mills per kilowatt-hour for the reference coal-fired boiler plant. It is concluded that further study of these retrofit options is warranted. Actual implementation of any of the retrofit designs described in this study must await commercial demonstration of the particular coal gasification process.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 5704, 6150, 6252

5692 **Fire protection: an assessment of standards for thermal power plants. Consultant report.** Sacramento CA; California Energy Commission (1978). 81p. (NP—24110).

A study was conducted to identify existing prescribed fire protection standards for thermal power plants and to determine their adequacy regarding the health and safety of plant personnel and the general public. It is concluded that fires and explosions are not a serious problem in thermal power plants in California, and that the fire protection standards presently utilized by the utilities in the state are adequate. There seems to be no immediate need for an active enforcement program at the State level for assuring a reasonable level of fire protection for thermal power plants. It is recommended that the Energy Commission assume a monitoring or overview posture in regard to the fire protection aspects of thermal power plants in the State of California. It is also recommended that a comprehensive data acquisition system be developed and implemented by the Energy Commission in cooperation with the utility companies and the State Fire Marshal's office.

THERMAL EFFLUENTS

5693 (EPRI-EA—1111(Vol.1)) **Methodology for evaluation of multiple power plant cooling system effects. General description and screening. Final report, July 1979.** (Tetra Tech, Inc., Lafayette, CA (USA)). 1979. 116p. Dep. NTIS, PC A06/MF A01.

The computational procedures and models developed as part of this project are designed to be used as an aid in evaluating the ecosystem level impacts of multiple power plant cooling system operation on a single water body. The models are designed to simulate the behavior of a simplified ecosystem with the added stress of cooling system operation. The basic concept of the methodology is to simulate the ecosystem simultaneously with a simulation of cooling water withdrawal, plant passage (with various induced mortality rates) and discharge back to the ecosystem. It should be noted that many of the specific formulations and rate constants are open to debate. The programs have been written so that the user can input site- or species-specific information where appropriate, yet can use default values contained in the methodology for sensitivity analysis or when no better information is available. The value of the methodology lies in its ability to simultaneously consider a large number of interacting processes. The specific formulations and constants can be easily overridden or changed when needed. By considering what are thought to be the important state variables and processes occurring in an aquatic ecosystem, the methodology is ideal for comparing alternatives, determining sensitivity and testing assumptions. This volume provides typical cooling system operational parameters, characteristics of different water body types, prescreening procedures and an overview of detailed assessment methods.

5694 (EPRI-EA—1111(Vol.2)) **Methodology for evaluation of multiple power plant cooling system effects. Technical basis for computations. Final report, July 1979.** (Tetra Tech, Inc., Lafayette, CA (USA)). 1979. 147p. Dep. NTIS, PC A07/MF A01.

The computational procedures and models developed as part of this project are designed to be used as an aid in evaluating the ecosystem level impacts of multiple power plant cooling system operation on a single water body. The models are designed to simulate the behavior of a simplified ecosystem with the added stress of cooling system operation. The basic concept of the methodology is to simulate the ecosystem simultaneously with a simulation of cooling water withdrawal, plant passage (with various induced mortality rates) and discharge back to the ecosystem. It should be noted that many of the specific formulations and rate constants are open to debate. The programs have been written so that the user can input site- or species-specific information where appropriate, yet can use default values contained in the methodology for sensitivity analysis or when no better information is available. The value of the methodology lies in its ability to simultaneously consider a large number of interacting processes. The specific formulations and constants can be easily overridden or changed when needed. By considering what are thought to be the important state variables and processes occurring in an aquatic ecosystem, the methodology is ideal for comparing alternatives, determining sensitivity and testing assumptions.

5695 (EPRI-EA—1111(Vol.3)) **Methodology for evaluation of multiple power plant cooling system effects. Data requirements. Final report, July 1979.** (Tetra Tech, Inc., Lafayette, CA (USA)). 1979. 198p. Dep. NTIS, PC A09/MF A01.

The computational procedures and models developed as part of this project are designed to be used as an aid in evaluating the ecosystem level impacts of multiple power plant cooling system operation on a single water body. The models are designed to simulate the behavior of a simplified ecosystem with the added stress of cooling system operation. The basic concept of the methodology is to simulate the ecosystem simultaneously with a simulation of cooling water withdrawal, plant passage (with various induced mortality rates) and discharge back to the ecosystem. It should be noted that many of the specific formulations and rate constants are open to debate. The programs have been written so that the user can input site- or species-specific information where appropriate, yet can use default values contained in the model for sensitivity analysis or when no better information is available. The value of the methodology lies in its ability to simultaneously consider a large number of interacting processes. The specific formulations and constants can be easily overridden or changed when needed. By considering what are thought to be the important state variables and processes occurring in an aquatic ecosystem, the methodology is ideal for comparing alternatives, determining sensitivity and testing assumptions. This volume describes the data requirements for use of the methodology.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 5314, 5333, 5339, 5689

5696 (PB—289878) **Combustion modification effects on NOx emissions from gas-, oil-, and coal-fired utility boilers. Final report, July 1976-August 1978.** Dykema, O.W. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Dec 1978. 99p. NTIS PC A05/MF A01.

The report represents the conclusion of 4 years of analysis of large quantities of emissions, operating conditions, and boiler configuration data from full-scale multiple-burner, electric-generating

boilers firing natural gas, oil, and coal fuels. The overall objective of the study was to develop from this data: (1) further understanding of the effects of combustion modifications on combustion, and the resulting effects on NOx emissions; and (2) directly applicable guidelines for the application of combustion modification techniques for the control of NOx emissions in full-scale operating utility boilers. The report includes: (1) discussion of modeling techniques used to analyze the data; (2) conclusions relative to the sources of NOx within the furnace; (3) guidelines for NOx reduction; and (4) an example application of the guidelines. Boiler firing types include single-wall, opposed and tangential configurations. The report concludes that NOx emissions are generated, in varying degrees, from conversion of fuel-bound nitrogen (the predominant source), heterogeneous combustion and mixing zone, second-stage mixing zone, and active burner region. Maintaining very fuel-rich initial combustion conditions, holding the initial peak combustion temperature to <2050 K, and delaying fuel gasification and mixing until the gas has been cooled somewhat should reduce NOx emissions from all four main sources.

5697 (PB—289921) **Evaluation of dry sorbents and fabric filtration for FGD (flue gas desulfurization). Final task report, March 1976-October 1978.** Lutz, S.J.; Christman, R.C.; McCoy, B.C.; Mulligan, S.W.; Slimak, K.M. (TRW, Inc., Durham, NC (USA)). Jan 1979. Contract EPA-68-02-2165. 155p. NTIS PC A08/MF A01.

The report gives results of a study to assess the use of baghouses (fabric filtration) to control air pollutant emissions (particularly SOx) from large utility combustion sources. The assessment included sorbent costs, and system capital, operating, and disposal costs. SO_2 would be removed by introducing powdered dry sorbent into the gas stream or by precoating the baghouse fabric with sorbent. The objective of the study was to determine if the apparent economic advantage exhibited by the concept would remain intact after independent third-party evaluation and if the economic (and other) advantages are sufficiently large to warrant further development of the process at field installations. The evaluation shows that the dry sorbent baghouse FGD process exhibits an economic advantage when compared with current lime and limestone scrubbing technology when applied to Western power plants burning low sulfur coal. Further demonstrations on the pilot plant scale have been recommended, particularly at high temperatures. The need for extensive user (electric utility) commitment, in order to justify the considerable capital investment needed to open a commercial-scale sorbent (nahcolite) mine may represent the greatest barrier to commercialization of the process.

5698 (PB—289968) **Assessment of manufacturers capability to meet requirements for particulate controls on utility and industrial boilers. Final report.** Patel, V.P. (Industrial Gas Cleaning Inst., Inc., Stamford, CT (USA)). Feb 1978. Contract EPA-68-02-2532. 18p. NTIS PC A02/MF A01.

A survey of manufacturers of particulate control equipment was conducted to determine the industry's capability to meet the demand for control equipment required by a change in particulate emission standards for utility and industrial boilers. The report details the numbers and sizes of fabric filters and electrostatic precipitators that can be designed and installed in the 1978-1982, 1983-1987, 1988-1992 time spans. Attention was also given to factors which might prove to be bottlenecks.

5699 (PB—290104) **High-temperature, high-pressure particulate control with ceramic bag filters. Final report, August 1976-August 1978.** Shackleton, M.A. (Acurex Corp., Mountain View, CA (USA)). Oct 1978. Contract EPA-68-02-2169. 78p. NTIS PC A05/MF A01.

The report gives results of bench-scale research indicating that fine particle control at high temperature and pressure can be achieved using barrier filtration by ceramic bag filters. Evidence supporting this contention includes: (1) 'blanket' ceramic fiber materials (felts) consisting of small diameter fibers (3.0 micrometers) appear to be the most promising materials for high-temperature and -pressure applications because of their combination of good filtration performance and relatively high strength; and (2) accelerated media cleaning tests at high temperatures and pressures show that several ceramic filter structures are capable of surviving in excess of 50,000 cleaning pulses while maintaining pressure drop at acceptable levels.

5700 (PB—290169) **Electrostatic precipitator cost for large coal-fired steam generators. Final report.** Loudin, D.J. (Industrial Gas Cleaning Inst., Inc., Stamford, CT (USA)). Feb 1977. Contract EPA-68-02-1473. 50p. NTIS PC A03/MF A01.

Capital and annualized costs for electrostatic precipitators for use on large coal-fired steam generators are estimated for a variety of conditions: (1) boiler sizes of 200 and 700 megawatts; (2) hot and cold side units; (3) emission standards of 13, 22, and 43 nanograms per joule (0.03, 0.05, and 0.10 lbs particulate per million Btus); and (4) low and high resistivity coal.

5701 (PB—290172) **Flue gas desulfurization system manufacturers survey. Final report.** Patel, V.P. (Industrial Gas Cleaning Inst., Inc., Stamford, CT (USA)). Nov 1977. Contract EPA-68-02-2532. 29p. NTIS PC A03/MF A01.

A survey of manufacturers of flue gas desulfurization equipment was conducted to determine the industry's capability to meet the demand for control equipment required by a change in the SO_2 emission standards for boilers. The report details the processes available, the capability of companies to design and install various sizes of FGD systems, manufacturers' guarantees, raw material availability, and availability of equipment and manpower.

5702 (PB—290198) **SO_2 abatement for stationary sources in Japan. Final report, September 1977-October 1978.** Ando, J. (Chuo Univ., Tokyo (Japan)). Nov 1978. Contract EPA-68-02-2161. 331p. NTIS PC A15/MF A01.

The report gives results of a study of Japanese government efforts to regulate SOx emissions: the efforts were prompted by serious air pollution problems in Japan during the 1960s. Several technologies are being developed including production of low sulfur gas from coal, fuel desulfurization, and fluidized bed combustion. However, predominant methods currently used for SO_2 control in Japan are burning low sulfur fuels and flue gas desulfurization (FGD). Development and application of FGD technology in Japan has preceded similar development in other countries, resulting in a significant reduction in ambient SO_2 levels. The stringent, daily average ambient standard of 0.014 ppm has almost been achieved. Several types of FGD systems are currently in use in Japan, including wet lime/limestone, indirect and modified lime/limestone, regenerable, and simultaneous NOx/SOx. These processes have been operated satisfactorily on a commercial scale. Both SO_2 removal and operability are typically over 90%. Removals and operabilities of 98-99% can be achieved at higher costs.

POWER TRANSMISSION AND DISTRIBUTION

AC SYSTEMS, EHV AND UHV

5703 (DOE/EV—0056) **Potential environmental effects of 765-kV transmission lines: views before the New York State Public Service Commission, Cases 26529 and 26559, 1976-1978.** Scott-Walton, B.; Clark, K.M.; Holt, B.R.; Jones, D.C.; Kaplan, S.D.; Krebs, J.S.; Polson, P.; Shepherd, R.A.; Young, J.R. (SRI International, Menlo Park, CA (USA)). Nov 1979. Contract EY-76-C-03-0115-120. 154p. Dep. NTIS, PC A08/MF A01.

Testimony given before the New York Public Service Commission in two recent cases on the potential environmental effects of 765-kV overhead ac transmission lines is reviewed. The testimony focused on the potential effects of audible noise, on the potential biological effects of the electromagnetic fields, on the potential for electric shocks to people who touch vehicles parked under the proposed lines, on the potential effects of the electromagnetic fields on electronic cardiac pacemakers, and on potential effects of ozone produced by corona discharge from the lines. The testimony fully explored these questions; however, it did not resolve all of them. The testimony indicates potential impacts from the audible noise and from the electrostatic shocks that people can receive when they touch a large vehicle parked under the lines. The testimony also indicates that certain cardiac pacemaker and lead combinations may, under certain circumstances, undergo reversion to a fixed rate of pacing in the presence of the fields under the lines, but that little risk to cardiac patients results except possibly for those patients for whom competition between the heart's own rate and the pacemaker rate presents a health risk. The testimony fails to demonstrate biological hazards from the field; further research is necessary to understand better the effects of the fields on biological systems. The testimony indicates that ozone produced by the lines will not significantly affect the environment.

5704 (PB—292391) **Evaluation of health and environmental effects of extra high voltage (EHV) transmission. Final report.** Frazier, M.J. (IIT Research Inst., Chicago, IL (USA)). Feb 1979. Contract EPA-68-01-4604. 250p. NTIS, PC AA11/MF A01.

The report presents an analysis of material received by the Environmental Protection Agency in response to a request for information on the health and environmental effects of the operation of extra-high-voltage (EHV) transmission lines which was published in the Federal Register in March 1975. The health and environmental aspects of EHV transmission naturally divides into two broad areas. The first comprises concern over the possible effects caused by the electric and magnetic fields in the vicinity of the line. The second area of concern is with regard to effects caused by electrical discharges from the line. The report concludes that available information provides a good knowledge base on the various physical phenomena that result from the transmission of electrical power by EHV lines. It is reasonably well established that the normal environment produced by such transmission lines does not produce any

significant health or environmental risks. However, there appear to be areas where additional research is yet required.

NUCLEAR POWER PLANTS

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 5715, 5755, 5757, 5759, 5778, 5779, 5780, 5781, 5784, 5786

5705 (COO—34012-1) **Uranium utilization experience in Light Water Reactors.** Aucoin, P.A. (Nuclear Assurance Corp., Atlanta, GA (USA)). Sep 1979. Contract AC02-79ET34012. 130p. Dep. NTIS, PC A07/MF A01.

This analysis discusses the historical experience of operating Light Water Reactors with respect to achieved uranium utilization rates. The assumptions and method of approach are discussed. The data is presented in several ways. Historical specific energies have been determined for all operating cycles for each nuclear reactor having completed at least one cycle prior to April 1979. In addition, the data has been aggregated to illustrate the following: (1) performance histories of BWRs and PWRs, (2) reactors with a MWe rating above and below 800 MWe, (3) reactors which have operated for five cycles or more, and (4) chronological experience of annual discharges.

5706 (NUREG/CR—1012) **Procedure for the qualitative interpretation of fuel centerline thermocouple response to step-power decreases.** Cunningham, M.E.; Lanning, D.D.; Montgomery, S.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 113p. Dep. NTIS, PC A06/MF A01.

The present calculational techniques are reviewed that may be used to interpret the transient response of fuel centerline thermocouples to step decreases in rod power. A new technique involves plotting the natural logarithm of the normalized thermocouple data versus time, plotting various calculations in the same way, and observing the curvature of the resulting lines. Also described is the small computer code, MWRAM, which facilitates testing various models against transient data. Transient data from IFA-513 is presented. This test assembly in the Halden Reactor, Norway, is jointly sponsored by the Nuclear Regulatory Commission and the Halden Project. A comparison of MWRAM calculations with this data has shown that fuel cracking appears to greatly influence the heat transfer modes in the fuel rod. A method of estimating the effective fuel-cladding gap size from this transient data is also discussed.

5707 (NUREG/CR—1132) **Survey of potential light water reactor fuel rod failure mechanisms and damage limits.** Courtright, E.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract EY-76-C-06-1830. 46p. (PNL—2787). Dep. NTIS, PC A03/MF A01.

The findings and conclusions are presented of a survey to evaluate current information applicable to the development of fuel rod damage and failure limits for light water reactor fuel elements. The survey includes a review of past fuel failures, and identifies potential damage and failure mechanisms for both steady state operating conditions and postulated accident events. Possible relationships between the various damage and failure mechanisms are also proposed. The report identifies limiting criteria where possible, but concludes that sufficient data are not currently available in many important areas.

5708 (PNL—2575) **LWR nuclear fuel bundle data for use in fuel bundle handling.** Weihermiller, W.B.; Allison, G.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 42p. Dep. NTIS, PC A03/MF A01.

Although increasing numbers of spent light water reactor (LWR) fuel bundles are moved into storage, no handling equipment is set up to manipulate all of the various types of fuel bundles. This report summarizes fuel bundle information of interest to the designer of such handling equipment. Dimensional descriptions are included with discussions of assembly procedure and manufacturer provisions for handling equipment. No attempt is made to make a complete compilation of dimensional information; the number of fuel bundle designs and design revisions makes it impractical. Because the fuel bundle designs are so varied, any equipment intended for handling all types of bundles will have to be designed with flexibility in mind. Besides the ability to manipulate fuel bundles in space, handling equipment may be required to locate an external surface or to position a cutting operation to avoid breaking a fuel rod pressure boundary. Even with the most sophisticated and flexible handling equipment, some situations will require use of the manufacturers' as-built descriptions of individual fuel bundles.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 5688, 5705, 5706, 5707, 5708, 5715, 5759, 5771, 5778, 5779, 5780, 5785, 5787

5709 (COO—4570-10) **Evaluation of tight-pitch PWR cores.** Correa, F.; Driscoll, M.J.; Lanning, D.D. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1979. Contract EN-77-S-02-4570. 202p. (MITNE—227; MIT-EL—79-022). Dep. NTIS, PC A10/MF A01.

The impact of tight pinch cores on the consumption of natural uranium ore has been evaluated for two systems of coupled PWR's namely one particular type of thorium system - $^{235}U/UO_2$: Pu/ThO_2 : $^{233}U/ThO_2$ - and the conventional recycle-mode uranium system - $^{235}U/UO_2$: Pu/UO_2. The basic parameter varied was the fuel-to-moderator volume ratio (F/M) of the (uniform) lattice for the last core in each sequence. Although methods and data verification in the range of present interest, 0.5 (current lattices) $< F/M < 4.0$ are limited by the scarcity of experiments with $F/M > 1.0$, the EPRI-LEOPARD and LASER programs used for the thorium and uranium calculations, respectively, were successfully benchmarked against several of the more pertinent experiments.

5710 (EGG—1183-4137) **Technical evaluation of the susceptibility of safety-related systems to flooding caused by the failure of non-category I systems for Palisades nuclear power plant.** Collins, E.K. (EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group). Oct 1979. Contract EY-76-C-08-1183. 33p. (UCRL—15107). Dep. NTIS, PC A03/MF A01.

The technical evaluation is presented of Consumers Power Company's Palisades nuclear power plant to determine whether the failure of any non-Category I (seismic) equipment could result in a condition, such as flooding, that might potentially adversely affect the performance of safety-related equipment required for the safe shutdown of the facility or to mitigate the consequences of an accident. Criteria developed by the US Nuclear Regulatory Commission were used to evaluate the acceptability of the existing protection as well as measures taken by Consumers Power Company to minimize the danger of flooding and to protect safety-related equipment.

5711 (EPRI-WS—78-94(Vol.1), pp 2.1-2.29) **Managing the Zion Unit 2 Cycle 2-3 refueling.** Budowle, R.J.; Murach, E.F. (Commonwealth Edison Co., Zion, IL). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

The Zion-Nuclear Power Station in Illinois has undergone two refueling outages. This paper details the second refueling outage of Zion-2, from February through April, 1978. Major work scheduled for the outage included: fuel assembly replacement, internal inspection of the reactor vessel hot leg nozzles, an emergency core cooling system full-flow test, generator tests, sludge lancing, installation of a loose-parts monitoring system, and upgrading fire protection. Six major occurrences resulted in extending the outage period by two weeks. The Zion management system is examined. Formal planning for the outage began four months before the outage starting date. Major successes and weaknesses are discussed specifically. Conclusions and recommendations for improved outage maintenance are given. 10 figures.

5712 (EPRI-WS—78-94(Vol.1), pp 4.1-4.10) **Use of Planalog at Arkansas Nuclear One, Unit One.** Holcomb, T. Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

The outage management system of the Arkansas Nuclear One, Unit one is summarized. With limited manpower the outage procedure must be streamlined but still be able to meet the requirements and needs of both the plant structure and the corporate structure. The functions and responsibilities of the outage coordinator are outlined. Outage preparation and control using the Planalog system are discussed. According to the author, even with the disadvantages of the Planalog system listed, it remains a field-proven, reliable tool for major outage activity control. 6 figures.

5713 (EPRI-WS—78-94(Vol.1), pp 5.1-5.22) **Computerized outage moodeling for Davis-Besse Nuclear Power Station Unit I.** Grime, L.A. (Toledo Edison Co., OH). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

The use of computer software to plan and implement the management of a major outage at Davis-Besse One is presented. A

good outage model must not only be able to accurately model a static outage in which everything goes as planned but must be easily modified so that it can model a realistic dynamic outage. A scheduled, short, routine outage at Davis-Besse One that eventually tripled the time schedule and required as much work as a refueling outage is discussed. The outage became known as the lumped burnable poison rod assembly removal outage. 10 figures.

5714 (EPRI-WS—78-94(Vol.1), pp 13.1-13.13) **Importance of maintainability to PWR steam generators.** Martel, L.J. (Electric Power Research Inst., Palo Alto, CA). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

Pressurized water reactor steam generator problems are high-priority utility concerns because they can significantly reduce the availability of large baseloaded plants. A steam generator owners group of 23 utilities has been formed to find solutions to the various steam generator problems. The Electric Power Research Institute manages the program for the utilities. Various forms of corrosion make up the major problems. The most serious form of corrosion in the steam generators has been denting. Denting and other major causes of steam generator damage are listed and discussed. Some options for correcting problems are also given. 1 figure, 4 tables.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 5780, 5975, 6130

5715 (GA-A—15569) **Personnel radiation exposure in HTGR and LWR plants.** Engholm, B.A. (General Atomic Co., San Diego, CA (USA)). Sep 1979. Contract AT03-76ET35300. 20p. Dep. NTIS, PC A02/MF A01.

Occupational radiation exposures at HTGR plants were compared with those at typical LWR facilities. Actual man-rem accumulations at the Peach Bottom 1 HTGR and at the Fort St. Vrain HTGR have been substantially lower than those at LWRs with similarly rated powers, when compared on the basis of man-rem/GW(e)y. The expected exposure rate for a large HTGR steam cycle or gas turbine unit is 70 man-rem/GW(e)y, while the design basis is 180 man-rem/GW(e)y. The results from Peach Bottom and FSV lend credence to these predictions, as do the exposures experienced in CO_2-cooled reactors with PCRVs. The comparable figure for actual LWR experience is 570 man-rem/GW(e)y.

5716 (NUREG/CR—0995) **Feasibility of monitoring the strength of HTGR core support graphite. Part II.** Morgan, W.C.; Becker, F.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 49p. (PNL—3126). Dep. NTIS, PC A03/MF A01.

The results reported establish the technical feasibility of a method for monitoring the strength of HTGR core support structures in situ. Correlations have been established between the velocity of an ultrasonic pulse and the compressive strength of four different grades of graphite. For some grades of graphite, one or more of the correlations are practically independent of oxidation profile in samples having cylindrical geometry (as in the core support posts). For other grades of graphite, and for other sample geometries, the oxidation-depth profile must be known in order to reliably predict the effect of oxidation on compressive strength.

5717 (ORNL/CSD/TM—78) **Numerical determination of inert gas permeability parameters of High-Temperature Gas-Cooled Reactor (HTGR) fuel-particles.** Tolliver, J.S. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Nov 1979. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

The high temperature diffusion of inert gases through an outer layer of dense carbon into the ThO_2 core of biso-coated High-Temperature Gas-Cooled Reactor (HTGR) fuel-particles is studied numerically. A mathematical model of diffusion through a dense spherical shell into a spherical core is used to numerically calculate the theoretical gas content of the core. This theoretical calculation, in tandem with an optimizing computer code and experimental data, is used to determine the diffusion coefficient of the shell and the porosities of the shell and inner core. The activation energy is also determined for use in an Arrhenius relationship between the diffusion coefficients and absolute temperature.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

5718 **Nuclear design analysis of Wolsung-1 CANDU-PHW nuclear generating station.** Chung, C.H. (Seoul National Univ., Korea); Oh, K.B.; Kim, C.H. *J. Korean Nucl. Soc.;* **10**: No. 4, 203-213(Dec 1978).

A combination of computer codes such as LATREP, HWRAXAV, and CITATION is utilized in an attempt to analyze the nuclear design characteristics of the CANDU-PHWR of the Wolsung Unit 1. The major nuclear properties to be computed are the lattice properties of CANDU fuel channel and the core channel power distribution. The computed results are compared with the PSR documentation for the Wolsung reactor. The observed discrepancies between our computations and the PSR values are discussed in terms of incomplete information on the description of the core configuration in the PSR and the different calculation methods.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 5748, 5754, 5756, 5762, 5763, 5764, 5765, 5766, 5767, 5769, 5773, 5774, 5777, 5780, 5788, 5957, 5966, 5968, 5974, 6007

5719 (ANL/ENG—79-05) **SLSF loop handling system. Volume I. Structural analysis.** Ahmed, H.; Cowie, A.; Ma, D. (Argonne National Lab., IL (USA)). Oct 1978. Contract W-31-109-ENG-38. 453p. Dep. NTIS, PC A20/MF A01.

SLSF loop handling system was analyzed for deadweight and postulated dynamic loading conditions, identified in Chapters II and III in Volume I of this report, using a linear elastic static equivalent method of stress analysis. Stress analysis of the loop handling machine is presented in Volume I of this report. Chapter VII in Volume I of this report is a contribution by EG and G Co., who performed the work under ANL supervision.

5720 (ANL/ENG—79-08) **SLSF loop handling system. Volume IV. Analysis verifications and supporting appendices.** Ahmed, H.; Malek, R.A.; Rafer, A.; Ma, D.; D'Souza, F.; Leonard, J.W. (Argonne National Lab., IL (USA)). Oct 1978. Contract W-31-109-ENG-38. 407p. Dep. NTIS, PC A18/MF A01.

SLSF loop handling system was analyzed for deadweight and postulated dynamic loading conditions. Some relevant backup appendices for the report are included.

5721 (CONF-790884—2) **Development of LIFE4-CN: a combined code for steady-state and transient analyses of advanced LMFBR fuels.** Liu, Y.Y.; Zawadzki, S.; Billone, M.C.; Nayak, U.P.; Roth, T. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA); Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). 1979. Contract W-31-109-ENG-38. 28p. Dep. NTIS, PC A02/MF A01.

From Post-SMiRT5 second international seminar on mathematical/mechanical modeling of reactor fuel elements; Berlin, F.R. Germany (20 Aug 1979).

The methodology used to develop the LMFBR carbide/nitride fuels code, LIFE4-CN, is described in detail along with some subtleties encountered in code development. Fuel primary and steady-state thermal creep have been used as an example to illustrate the need for physical modeling and the need to recognize the importance of the materials characteristics. A self-consistent strategy for LIFE4-CN verification against irradiation data has been outlined with emphasis on the establishment of the gross uncertainty bands. These gross uncertainty bands can be used as an objective measure to gauge the overall success of the code predictions. Preliminary code predictions for sample steady-state and transient cases are given.

5722 (CONF-791058—26) **Cross section adjustment applied to estimation of uncertainty in the breeding ratio of an LMFBR.** Marable, J.H.; Weisbin, C.R.; de Saussure, G. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Eleven fast-reactor benchmark experiments and two neutron-field benchmark experiments were applied to a least-squares adjustment of a 26-group cross section library based primarily on ENDF/B-IV. The covariance data include correlations between cross sections for different energies, reactions, and materials, and between integral experiments, and covariances of calculational bias factors due to specific modeling and calculational procedures. The results of the adjustment are applied to the determination of the uncertainties in the multiplication factor and in the breeding ratio of a large LMFBR design model fixed by the Large Core Code Evaluation Working Group (LCCEWG).

5723 (ESG-DOE—13290) **Sodium technology program. Quarterly technical progress report, July-September 1979.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 24 Oct 1979. Contract A103-76SF70027. 19p. AT.

Progress is reported for the following LMFBR-CRBR related activities: (1) sodium evaporation process development and (2) decontamination studies.

5724 (GA-A—15555) **Reliability comparison of forced and natural convection residual heat removal in the GCFR.** Raabe, P.; Taniguchi, T.; Torri, A. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76SF71023. 11p. (CONF-790816—80). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Loss of cooling consequences for all breeder cores require an increased reliability of the engineered Residual Heat Removal (RHR) systems provided to assure abundant cooling of the core at decay heat levels. An upflow GCFR core design offers the capability for pressurized decay heat removal by natural convection, thus enhancing core cooling reliability and diversity. A quantitative assessment is presented for the Residual Heat Removal reliability achievable with and without natural convection. The reliability gains due to natural convection are limited by the demand frequency for PCRV depressurization and by the equipment which has to change state in order to establish natural convection. The coolant circulation diversity accomplished with natural convection is a major advantage.

5725 (GA-A—15562) **Evaluation of molten fuel containment concepts for gas-cooled fast breeder reactors.** Kang, C.S.; Torri, A. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76SF71023. 11p. (CONF-790816—81). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Four in-vessel molten fuel containment concepts for the GCFR were compared, namely, (1) a ceramic crucible, (2) a borax bath, (3) a heavy metal bath, and (4) a steel bath. The ceramic crucible is the simplest but depends on substantial upward heat removal. The borax bath and the heavy metal bath concepts offer better performance but would require design changes and an increased experimental effort. The steel bath concept is a good compromise and has potential for further improvement by combining it with the essential features of other concepts, i.e., the crucible or the heavy metal bath. It is concluded that several concepts could potentially exploit the normally provided cooled liner barrier in the PCRV cavity for post-accident fuel containment.

5726 (GEFR—00466) **Feasibility of acoustic leak location for WTD duplex-tube steam generators.** Gaubatz, D.C.; Greene, D.A.; Magee, P.M.; McMurtrie, K.R. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jul 1979. Contract EY-76-C-03-0893-030. 115p. AT.

It has been demonstrated that leak localization is feasible at all locations within the two Westinghouse Tampa Division (WTD) duplex-tube steam generator designs. All of the WTD requirements for leak location can be achieved. The primary WTD design requirement is that a small leak of helium gas into the shell-side sodium be located to within a cluster of seven tubes in less than four hours after hot standby conditions are achieved. This requirement can be met or exceeded everywhere in the steam generator, provided the acoustic sensors (accelerometers) are premounted on the steam generator vessel. It was found to be necessary to simulate experimentally those regions of the WTD steam generator which differ significantly from the vessel wall-sodium annulus-shroud configuration of the Clinch River steam generators. Of particular concern were the convoluted bellows section and the inlet/outlet regions. Feasibility of leak location was experimentally demonstrated for both regions. The feasibility study summarized in this report consisted of twelve tasks: six areas of analysis and six experimental investigations of geometric regions, or problems, associated with the specific WTD Steam Generator designs.

5727 (GEFR-SP—177) **Reliability of liquid metal breeder reactor cooling systems.** Crellin, G.L.; Bazovsky, I. Sr. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 21 Sep 1979. Contract EY-76-C-03-0893-032. 29p. (CONF-800103—2). Dep. NTIS, PC A03/MF A01.

From Reliability and maintainability symposium; San Francisco, CA, USA (22 Jan 1980).

The reliability of the cooling systems employed during shutdown of Liquid Metal Fast Breeder Reactor is discussed. A commercial-sized breeder reactor was selected as an example for the reliability modeling of the cooling system. Markov models in the form of state transition diagrams are used to exploit the effect of repairs on system reliability. The actual calculations were performed by a reliability computer program developed by General Electric.

5728 (HEDL-SA—1948) **Radioactive corrosion product release potential in sodium-cooled reactors.** Colburn, R.P.; Taylor, G.R. (Hanford Engineering Development Lab., Richland, WA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Reactors Div.). Sep 1979. Contract EY-76-C-14-2170. 23p. Dep. NTIS, PC A02/MF A01.

A mathematical analysis of the rate of release and deposition of radioactive corrosion products from the core of liquid sodium cooled reactors is outlined and numerical results presented as a function of reactor design parameters for a number of reactors. It is shown that the activity release potential of advanced sodium-cooled reactors (FFTF and CRBRP) is about two orders of magnitude larger than that of older reactors such as EBR-II, and RAPSODIE. Radiation levels up to 6 R/hr are predicted for FFTF and CRBRP primary system components after 20 years of operation. The model can be used to predict the sensitivity of activated corrosion product release to changes in operating parameters for various existing and planned reactors.

5729 (INIS-mf—4498, pp vp) **Development of a finite-strain fuel-element model.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

The LIFE-III computer code has been developed to describe the steady-state performance of LMFBR fuel rods. The mechanical analysis in the original version of the code was based on the assumption that the strains in the fuel and the cladding could be considered as infinitesimal. However, this assumption is grossly violated in the vicinity of the central void, since the opening and closing of the void involves displacements of the order of the void radius. To provide a more accurate description of the mathematical behavior of the fuel element, a finite-strain fuel-element model was developed. The finite-strain calculations in the modified code are based on an incremental analysis. The deformations are assumed to be axisymmetric. The fuel element is divided into a number ($<=10$) of axial segments. Each segment is assumed to be in a state of generalized plane strain. The deformation history of the fuel element is analyzed in discrete time steps, and the basic geometry of the element is updated after each time step.

5730 (INIS-mf—4498, pp vp) **DDT-A 3-dimensional program for the analysis of bowed reactor cores.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

A 3-dimensional code was developed, to allow a good description of the whole core bowing behavior. Each single hexagonal element is described by a simple beam with 6 springs in horizontal planes where contact with other elements is possible. Each force is divided in x- and y-directions of the coordinate system. The contact forces must be in equilibrium with the mechanical displacements in both directions. Because friction forces are not included in this analysis, all forces are assumed to act normal to contacting surfaces. Gaps may open and close and contact forces may only be compressive. Because of these nonlinearities, standard mathematical techniques for solving linear structural problems are not directly applicable. So an iterative procedure is applied to achieve the equilibrium force configuration. Each iteration step corrects the largest force discrepancy between neighbouring elements. This technique requires a long computer running time to converge, but the locations of gaps and contacts normally do not change if a rough equilibrium is found. This gap distribution is used to formulate a set of linear equations which can be solved directly. The solution is checked against the start-up gap distribution. The code can handle 30°, 60°, 120° sectors of complete reactor cores. The system boundaries are symmetrically. The next step of the development is to take the friction forces into consideration which originate from the different directions of element movements. Results for a 120° sector of the KNK II reactor and for a 30°-sector of SNR 300 are available.

5731 (LA—7901-MS) **Preliminary fabrication studies of alternative LMFBR carbide fuels.** Gutierrez, R.L.; Herbst, R.J.; Johnson, K.W.R. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

Preliminary fabrication studies were made of various compositions of thorium-uranium carbide and thorium-plutonium carbide fuel pellets that were prepared using the carbothermic reduction process. Temperatures of 1750 and 2000°C were used during the reduction cycle. Sintering temperatures of 1800 and 2000°C were used to prepare fuel pellets of low (87%) and high (> 94%) theoretical densities.

5732 (ZPR-TM—349) **Experimental studies of large conventional LMFBR cores at ZPPR.** Lineberry, M.J.; Carpenter, S.G.; Beck, C.L.; McFarlane, H.F.; Collins, P.J.; Olsen, D.N.; Grasseschi, G.L.; Kaiser, R.E.; Maddison, D.W. (Argonne National Lab., Idaho Falls, ID (USA)). 5 Sep 1979. Contract W-31-109-ENG-38. 22p. (CONF-790933—4). Dep. NTIS, PC A02/MF A01.

From IAEA international symposium on fast reactor physics; Aix-en-Provence, France (24 Sep 1979).

Results of a critical experiment program for 700 MW(e) LMFBRs are reviewed. Both a clean bench-mark assembly and one simulating a power reactor design were constructed. Experiments discussed include reaction rate distributions and ratios, control rod

worths and interactions, and sodium coefficients. Analysis of these experiments with ENDF/B Version IV cross sections is reported. The comparison between calculated and measured parameters is not too different in these cores than in the 350 MW(e) assemblies. An exception is that the radial fission rate is calculated up to 3% too high at the edge of the inner core relative to the core center.

5733 Molten-salt reactors for efficient nuclear fuel utilization without plutonium separation. Engel, J.R.; Rhoades, W.A.; Grimes, W.R.; Dearing, J.F. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **46**: No. 1, 30-43(Nov 1979).

Molten-salt reactors (MSRs), because of the fluid nature of the fuel, appear to provide an attractive approach to efficient fuel utilization in the thorium-^{233}U cycle as well as a means for limiting the availability of plutonium and the general proliferation risks associated with nuclear power generation. High-enrichment ^{233}U systems could, in principle, be operated with positive breeding gains to effectively eliminate plutonium as a nuclear fuel. However, such systems would be proliferation sensitive. Concept modifications (short of denaturing the uranium fuel) can be conceived to enhance the proliferation resistance of high-enrichment MSRs, but it is doubtful that sufficient enhancement could be achieved to make the systems suitable for deployment other than at secure sites. Denaturing the uranium in an MSR introduces some plutonium into the fuel cycle and generally degrades its breeding performance. Nevertheless, a denatured MSR with full-scale on-site fuel reprocessing appears to be capable of break-even breeding. In addition, the plutonium (most of which is consumed in situ) would be of poor quality and could never be isolated from all other undesirable nuclides. Thus, such systems would provide for efficient utilization of uranium resources in a proliferation-resistant environment while limiting the amount of plutonium (and transplutonium actinides) that would have to be handled as waste. The development of commercial MSRs by early in the 21st century appears to be technologically feasible.

5734 Preliminary analysis and screening criteria for elevated temperature piping. Minami, H.M.; Naugle, F.V. Contract EY-76-C-03-0824-021. New York, NY; American Society of Mechanical Engineers (1979). 7p. (CONF-790615—28). $3.00.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

The complexities of the ASME Class 1 nuclear elevated temperature structural design criteria precludes the possibility of performing a complete Code Case 1592 analysis for all of the alternative designs normally investigated in the course of the design of a Liquid Metal Fast Breeder Reactor (LMFBR) high-temperature piping system. To enable the piping design to proceed on an orderly controlled basis, the piping design analysis is separated into the following phases: (a) screening analysis to determine pipe routing feasibility, (b) preliminary analysis to determine pipe support configuration, and (c) final design analysis (including transients) to demonstrate Code compliance. The application of the first phases of this procedure is demonstrated by a summary of the analyses performed in the development of the preliminary design configuration for the primary system of a commercialized LMFBR.

ECONOMICS

REFER ALSO TO CITATION(S) 5866

CONSTRUCTION AND OPERATION

5735 (EPRI-WS—78-94(Vol.1)) **Workshop proceedings: outage planning and maintenance management.** (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1979. 260p. (CONF-7808113—(Vol.1)). Dep. NTIS, PC A12/MF A01.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

Papers are presented on the state of the art of outage planning and maintenance management for both nuclear and fossil-fuel power plants. Discussions include management aids, purchasing and stores, designing for maintainability, and impacts of other activities on maintenance. Each paper was separately processed for the Energy Data Base. (HDR)

5736 (EPRI-WS—78-94(Vol.1), pp 6.1-6.27) **Contemporary trends in outage planning methodologies.** Heneage, J.F.; Chen, F.T.W. (Energy, Inc., Idaho Falls, ID). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

Various methods and systems currently being employed by utilities to enhance outage planning are examined. The authors show that these methods are not new, but are, instead, a subset of tried and proven techniques, developed within the scope of science of operations research. Some of the more successful current applications are highlighted. As utilities continue to search for and implement outage planning systems, a pattern is followed. This pattern indicates that after the first few outages, planners become disenchanted with manual systems and begin to experiment with mechanical systems. Again, after a few more outages, and with a maturing plant, planners look to automated systems. The authors add that the automated systems being used today are by no means static. 18 references. 10 figures.

5737 (EPRI-WS—78-94(Vol.1), pp 7.1-7.27) **Results of DOE Phase I refueling/maintenance outage improvement program.** Thompson, C.A. (Dept. of Energy, Washington, DC). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

In 1976 the Energy Research and Development Administration initiated the light water reactor technology program. The objective of Phase I of this program, the refueling/maintenance outage improvement program, is to assist industry to achieve improved outage procedures and equipment. Phase I consisted of observation of refueling outages by independent observers and preparation of recommendations for (1) modifications of procedures, scheduling, and other outage management methods and (2) use of new or revised refueling, maintenance, and inspection equipment in both currently operating and new plants. The results of Phase I are arranged in three parts in this presentation: estimates of overall outage savings obtainable by full implementation of the recommendations; a summary of the recommended improvements; and a discussion of improvements already implemented at the observation plants. Examples of recommendations for future use and of improvements already implemented are included.

5738 (EPRI-WS—78-94(Vol.1), pp 9.1-9.21) **Engineering scale model as a maintainability design tool.** Booth, L.E. (Bechtel Power Corp., Los Angeles, CA). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

Replacement energy costs for some nuclear power reactors can approach $750,000 per day (for one unit). Penalities of this magnitude place a heavy burden on the maintainability and maintenance aspects of power generating stations. If a maintainability program results in the reduction of downtime by only a few days over the life of the unit, that alone will pay for the investment in a maintainability program and the cost of an engineering scale model. The use of the engineering scale model for maintenance studies primarily involves: providing for adequate pull space; checking for interference during equipment removal; and checking for rigging points and laydown areas. The design model approach, used here, means that the model is constructed from drawings prior to drawing release. Thus problems relating to any discipline including maintenance are corrected prior to construction in the field. The organization and procedure for the maintenance program are given. This presentation is intended to illustrate the use of the engineering scale model as a focal point for design and to demonstrate the practical benefits that can be achieved when maintainability, engineering design, and the design scale model are integrated early in the design. 7 references, 10 figures.

5739 (EPRI-WS—78-94(Vol.1), pp 12.1-12.8) **Summary of EPRI projects for improving power plant maintenance and maintainability.** Shugars, H.G.; Poole, D.N.; Pack, R.W. (Electric Power Research Inst., Palo Alto, CA). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

The Electric Power Research Institute is sponsoring projects to improve power plant maintenance and maintainability. Areas presently being emphasized are improvements in plant design for maintainability, improvements in performing nuclear plant refuelings, and development of on-line monitoring and diagnostic systems for various plant components. The seven projects are reviewed. They are: (1) human factors review of power plant maintainability; (2) refueling outage improvement; (3) on-line monitoring and diagnostics for power plant machinery; (4) acoustic emission and vibration signature analysis of fossil fuel plant components; (5) acoustic monitoring of power plant valves; (6) on-line monitoring and diagnostics for generators; and (7) detection of water induction in steam turbines. Each project contractor and the project manager are listed for reference. 8 references.

5740 (EPRI-WS—78-94(Vol.2)) **Workshop proceedings: outage planning and maintenance management.** (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1979. 224p. (CONF-7808113—(Vol.2)). Dep. NTIS, PC A10/MF A01.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

Four information packages prepared to provide background information to workshop participants are included. The workshop session topics include: (1) management aids and software; (2) spare parts, purchasing, stores, and tools; (3) designing for maintenance and maintainability; and (4) impacts on maintenance. (HDR)

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

5741 Correlation of the Cesium-134/Cesium-137 ratio to fast reactor burnup. Phillips, J.R.; Barnes, B.K.; Bement, T.R. (Los Alamos Scientific Lab., NM). *Nucl. Technol.*; **46**: No. 1, 21-29(Nov 1979).

The correlation of $^{134}Cs/^{137}Cs$ to burnup in irradiated fast reactor fuel pins was investigated using nondestructive precision gamma-ray scanning. This correlation was significant within individual subassemblies provided certain basic assumptions are satisfied. The calibration line must be calculated for each assembly based on independently measured burnup values. Differences in calibration lines for separate subassemblies are highly significant ($P < 0.005$). Therefore, application of this technique for the nondestructive measurement of burnup in fast reactor fuels has serious problems that must be considered.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 5977, 5992, 6094

5742 (INIS-mf—4506, pp vp) **Critical evaluation of the tangent modulus method of elasto-plastic fracture analysis.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

When a structure has a crack in it, on the one side, we consider the general strain lambda, as the driving force (independent variable), on the other side we consider that the strain epsilon, at the root of the crack will govern the failure. The HSST Program developed the Tangent Modulus Method for predicting the behavior of surface cracked structures at various temperatures.

5743 (INIS-mf—4543, pp vp) **Low cycle fatigue of steels for nuclear pressure vessels in hot water.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

Low cycle fatigue analysis is a very important problem in structural mechanics, especially for nuclear pressure vessels. The design procedure is based on the knowledge of the experimental results on test specimen. The design curves are based on tests in air at room temperature. But the fatigue behavior may be affected by hot water environment when light water reactors are concerned. So it would be useful to get experimental results for reactor steel samples in such conditions. A general program on low cycle fatigue in hot water is in progress at Saclay in order to assess the conservatism of design fatigue curves. In order to keep control of water chemistry, the test rig is connected with the PRIMEAU loop and therefore a constant flow of water is obtained through the specimens. Tested samples are small strips of rectangular cross section (2x10x61 mm). They are loaded in circular bending with controlled deflection. Practically they are placed between four supports, two moving and two fixed. The water temperature is kept near 265°C while the oxygen and hydrogen contents and the pH are monitored. A frequency as low as 0.1 cpm has been chosen in order to take into account time effects. Calibration tests in air at room temperature are also made with the same type of device. Tests are now in progress on austenitic alloys and the available results are given. Tests on a ferritic steel have been completed. The steel is the french steel for light water reactor vessels, its specification is roughly according to the specification ASTM 508 (Cl 3), but with special requirements.

FUEL ELEMENTS

5744 (ORNL—5599) **Determination of friction factors and heat transfer coefficients for flow past artifically roughened surfaces.** Hodge, S.A.; Sanders, J.P.; Klein, D.E. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 223p. Dep. NTIS, PC A10/MF A01.

A critical review of the assumptions, theoretical foundations, and supporting experimental evidence for the analytical procedures in current use for evaluation of the effects of artificial surface roughening on friction factor and Stanton number is provided. Recommendations are given concerning the application of these procedures to rough rod bundles. A new method is demonstrated for determination of the slope and intercept of the universal logarithmic dimensionless velocity distribution law for fully rough flow past roughened surfaces without the need for experimental measurement of the velocity profile. The slope is shown to vary with the nature of the roughened surface and to deviate significantly from the slope for turbulent flow past smooth walls in some cases. It is further shown that the intercept, which is a boundary condition equivalent to the roughness parameter for friction, is independent of the width of the velocity profile. A similar method is developed for determination of the slope and intercept of the temperature distribution law, but additional experimental investigation is required before the efficacy of this application can be conclusively established.

5745 Defect scriber. Russell, H.C. (to Dept. of Energy). US Patent 4,151,773. 1 May 1979. Filed date 28 Apr 1978. 8p. PAT-APPL-901,045.

This disclosure describes a device for repeatably scribing a V-shaped scratch having sharply defined dimensions on the interior surface of a nuclear reactor fuel rod tube. A cutting tool having a V-shaped cutting tip is supported within the fuel rod tube so that the V-shaped cutting tip can be pivoted about an axis and scribe a scratch on the interior surface of the fuel rod tube. Lengthwise the scratch runs parallel to a line drawn through the axis of the fuel rod tube and is in the shape of an arc, and widthwise the scratch is V-shaped. This shape is used because the dimensions of the scratch can be plugged into appropriate formulas to calculate stress intensity of cracks in fuel rod tubes. Since the fuel rod tubes which are to be scribed may be radioactive, the scratching assembly is designed for use in a fixture which allows it to be operated in a cave by remote control handling devices.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 6165

SITING

5746 (INIS-mf—4763) **Nuclear power in rock. Principal report.** (Statens Vattenfallsverk, Stockholm (Sweden)). Jun 1977. 71p. Dep. NTIS (US Sales Only), PC A05/MF A01.

In September 1975 the Swedish Government directed the Swedish State Power Board to study the question of rock-siting nuclear power plants. The study accounted for in this report aims at clarifying the advantages and disadvantages of siting a nuclear power plant in rock, compared to siting on ground level, considering reactor safety, war protection and sabotage. The need for nuclear power production during war situations and the closing down of nuclear power plants after terminated operation are also dealt with.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 6162, 6236

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 6245

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 5768, 5770, 5775

5747 (ANL/EBR—106) **Bibliography of publications on Experimental Breeder Reactor No. II (ERB-II). 1955-July 1979.** Berg, D.B. (comp.). (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 111p. Dep. NTIS, PC A06/MF A01.

This bibliography is divided into 15 broad areas, or categories, of interest. The same publication is listed in more than one category if its content applies to several areas of interest. Under each category, the publications are listed (1) by calendar year of publication and (2) then alphabetically by last name of the first author given. Publications that have no evident author (or compiler or editor) are listed alphabetically by title at the end of the listing for the calendar year in which they were published. Only open literature (that which can be obtained through libraries and other sources available to the public) are listed.

5748 (ANL/ENG—79-07) **SLSF loop handling system. Volume III. AISC code evaluations and analysis of critical attachments.** Ahmed, H.; Cowie, A.; Malek, R.A.; Rafer, A.; Ma, D.; Tebo, F. (Argonne National Lab., IL (USA)). Oct 1978. Contract W-31-109-ENG-38. 263p. Dep. NTIS, PC A12/MF A01.

SLSF loop handling system was analyzed for deadweight and postulated dynamic loading conditions using a linear elastic static equivalent method of stress analysis. Stress computations of Cradle and critical attachments per AISC Code guidelines are presented. HFEF is credited with in-depth review of initial phase of work.

5749 (CONF-791124—1) **LOFT facility and test program.** McPherson, G.D. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Nov

1979. Contract EY-76-C-07-1570. 15p. Dep. NTIS, PC A02/MF A01.

From GRS-Fachgesprach; Munich, F.R. Germany (30 Nov 1979).

The Loss-of-Fluid Test (LOFT) test facility, program objectives, and the experiments planned are described. The LOFT facility is related to the smaller Semiscale facility and the larger commercial pressurized water reactors. The fact that LOFT is a computer model assessment tool rather than a demonstration test is emphasized. Various types of reactor safety experiments planned through 1983 are presented.

5750 (HEDL-SA—1642-FP) **Methods of assuring design adequacy of seismic III/I supports.** Summers, G.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1979. Contract EY-76-C-14-2170. 11p. (CONF-790802—78). Dep. NTIS, PC A02/MF A01.

From International conference on structural mechanics in reactor technology; Berlin, F.R. Germany (13 Aug 1979).

After construction of the FFTF plant was virtually complete, special walkdown teams were sent to every cell containing SC I items. These teams, using specially derived zone of influence curves, identified those SC III items which could, if they or their support fail, impact the SC I items. A set of generic criteria was prepared for use by the walkdown teams in the field qualifying the SC III items. These items are referred to as III/I (SC III over SC I). The generic criteria include energy based relationships that can be used to determine whether a SC III item (the missile) has sufficient potential energy to damage a SC I item (the target) even if it does fall on it. Generic criteria were developed to qualify III/I conduit, lights, ducting, piping, pipe supports, and other items. Those items which can't be field qualified with the generic criteria are given detailed analysis. In cases where numerous SC III items threaten a single SC I item or a closely grouped set of SC I items, the SC I item is sometimes protected by providing a barrier between the missile and the target. A description of the analytical basis for the generic criteria is provided in the paper. Examples from FFTF are provided.

5751 (HEDL-SA—1917-FP) **Buffalo light water reactor calculations.** Ombrellaro, P.A.; Bennett, R.A.; McElroy, W.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1979. Contract EY-76-C-14-2170. 11p. (CONF-791051—7). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

An important objective of the light water reactor pressure vessel (LWRPV) surveillance dosimetry program is to validate and calibrate dosimetry and damage analysis techniques as well as to guide required neutron field calculations that are used to correlate changes in material properties with characteristics of the neutron irradiation field. As part of this activity, the Hanford Engineering Development Laboratory (HEDL) performed neutron flux calculations in a model of the light water test reactor of the Nuclear Science and Technology Facility of the State University of New York at Buffalo. The purpose of these calculations was to provide a consistent analysis base for projecting radiation damage produced by one reactor facility to that which would be incurred in another reactor facility.

5752 (HEDL-TC—1517) **Displacement sensor for measurement of fuel rod elongation in the LOFT reactors.** Billeter, T.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1979. Contract EY-76-C-14-2170. 41p. Dep. NTIS, PC A03/MF A01.

Qualification tests conducted for a period of 700 hours of each of three displacement measuring (LVDT) sensors confirmed applicability of the design for use in the Loss-of-Fluid-Test (LOFT) reactor. Operationally, the sensor satisfies all specified requirements for LOFT. Even for imposed temperature transients at rates up to 100°F/s, the indicated displacement remained within the allowed maximum error band of +- 10% of reading. The 0.6-inch O.D. by 5.5-inch long sensor exhibited a linearly related signal output variation for displacement variations of up to 1-inch range. Long term operation at temperatures of 100°F to 800°F caused no perceptible permanent change of operating characteristics.

5753 **Observations of dilation and bowing in Experimental Breeder Reactor II ducts and cladding.** Walters, L.C.; Walter, C.M. (Argonne National Lab., Idaho Falls, ID). *Nucl. Technol.;* **46**: No. 1, 134-148(Nov 1979).

Irradiation-induced creep and swelling of stainless-steel Experimental Breeder Reactor II (EBR-II) components have been the subjects of intense surveillance programs during the operation of the EBR-II. Dilation, length change, and bow due to creep and swelling of stainless-steel ducts have all been of concern during the operation of the EBR-II, but in no instance have significant reliability or safety problems arisen due to these phenomena. Driver-fuel elements of two different designs have been irradiated to cladding breach. It was demonstrated that metal driver fuel is capable of high burnup when designed for interconnected porosity prior to fuel-cladding contact. Cladding breaches were found either adjacent to the fuel column or in the fuel-restrainer dimpler. The breach mode was intergranular cracking at both locations.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 5692, 6037, 6260

5754 (ANL-CT—80-1) **Comparative transient analysis of metal and oxide fueled LMFBR.** Saphier, D.; Madell, J.T. (Argonne National Lab., IL (USA)). Sep 1979. Contract W-31-109-ENG-38. 125p. Dep. NTIS, PC A06/MF A01.

The neutronics and thermodynamics of an LMFBR primary system have been simulated using the DSNP simulation language. A detailed fuel pin and its subchannel model were developed and included in the DSNP library. This permits the reactor core to be simulated with any number of pins having any number of radial and axial nodes. The metal fueled core transients were compared to transients of an oxide fueled core, the conclusion being that for the same perturbations the temperature transients are faster in the metal core. A comparison between pool-type and loop-type reactors was also performed, leading to a conclusion that the transients in the upper plenum temperatures are much slower in the pool-type reactor than in the loop-type reactor.

5755 (BNL-NUREG—2) **Effect of thermal-hydraulic feedback on the BWR rod drop accident.** Cheng, H.S.; Diamond, D.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 5p. (CONF-791103—44). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

An important design-basis accident for boiling water reactors (BWR's) is the rod drop accident (RDA). This accident is defined to be a rapid reactor transient caused by an accidental drop (out of the core) of the highest-worth control rod at various conditions ranging from cold start-up to about 10% of rated power. For most BWR designs the highest worth rod is normally situated at the center of the core. Despite the fact that the chance of a RDA in extremely unlikely, the consequence of the RDA is of concern because of the potential for damage to fuel rods. Neglecting moderator feedback during the RDA is a poor assumption because energy is deposited in the fuel over a 3 to 4 second time period and hence there is time for heat to be conducted to the coolant. This may tend to ameliorate the accident considerably. Evaluation of the thermal-hydraulic feedback effect on the RDS in a BWR has been scarce in the literature. The object of this paper is to demonstrate the beneficial effect of thermal-hydraulic feedback in the RDA.

5756 (CONF-790816—75) **Studies of the role of molten materials in interactions with UO_2 and graphite.** Fink, J.K.; Heiberger, J.J.; Leibowitz, L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Graphite, which is being considered as a lower reactor shield in gas-cooled fast reactors, would be contacted by core debris during a core disruptive accident. Information on the interaction of graphite, UO_2, and stainless steel is needed in assessing the safety of the GCFR. In an ongoing study of the interaction of graphite, UO_2, and stainless steel, the effects of the steel components have been investigated by electron microprobe scans, x-ray diffraction, and reaction-rate measurements. Experiments to study the role of the reaction product, $FeUC_2$, in the interaction suggested that $FeUC_2$ promotes the interaction by acting as a carrier to bring graphite to the reaction site. Additional experiments using pyrolytic graphite show that while the reaction rate is decreased at 2400 K, at higher temperatures the rate is similar to that using other grades of graphite.

5757 (EGG-CAAP—5037) **RELAP4/MOD6 data comparisons of BWR-BD/ECC Tests 6006 and 6007.** Dallman, R.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1979. Contract EY-76-C-07-1570. 44p. Dep. NTIS, PC A03/MF A01.

Comparisons between the General Electric Two-Loop Test Apparatus experimental data and RELAP4/MOD6, Update 4 calculations for Tests 6006 and 6007 are presented. The study was conducted as part of the Idaho National Engineering Laboratory continuing technical support to the Nuclear Regulatory Commission for Industry Cooperative Programs. Conclusions concerning the capabilities of the code and recommendations pertaining to both the experimental facility and the code are given.

5758 (EGG-ISSS—5021) **Verification of an optimal redundancy allocation methodology.** Rasmuson, D.M. (Idaho National Engineering Lab., Idaho Falls (USA)). Sep 1979. Contract EY-76-C-07-1570. 48p. Dep. NTIS, PC A03/MF A01.

This document presents the results of a study to verify that the optimal redundancy allocation methodology developed at EG

and G Idaho is applicable to engineered systems in the nuclear industry. A sample system is described for which redundancies were introduced by the methodology to be verified. The resultant system was analyzed using fault tree techniques and these results compared to those obtained using the optimal redundancy allocation methodology. This comparison constitutes the methodology verification.

5759 (EGG-LOFT—5008) **Evaluation of the ability of electrical rods to simulate nuclear rod behavior during a loss-of-coolant accident.** Tolman, E.L.; Gottula, R.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 16 Oct 1979. Contract EY-76-C-07-1570. 61p. (LTR—20-107). Dep. NTIS, PC A04/MF A01.

The purpose of this report is twofold: (1) to assess the adequacy of electrical rods to simulate nuclear rod behavior during loss-of-coolant-accident (LOCA) conditions, and (2) to identify ongoing tests specifically designed to directly compare electric and nuclear rod response during a LOCA. The capability and limitations of electric rods to simulate LOCA fuel rod response are reviewed. Two tests, the Halden IFA-511 test and the German PNS 4237 test, are being conducted to directly compare electric rod and nuclear rod response under LOCA conditions. The objectives and usefulness of these tests are reviewed.

5760 (EPRI-WS—78-94(Vol.1), pp 10.1-10.9) **Impact of fire prevention and security requirements on nuclear power plants.** McEwen, J.E. (KMC, Inc., Washington, DC). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

The impact of the Nuclear Regulatory Commission's latest major issues - physical security and fire protection - is discussed. The historical bases for the NRC's positions are outlined. While the author states the NRC's approach on each issue has been vigorous, in certain areas the approach has possibly been excessive. Major attention has been focused on operating plants, as opposed to shutdown plants. Little thought has been given to plant security during a major shutdown or maintenance activity. If physical security and fire protection are carefully considered, the effort could, according to the author, result in substantial cost savings to present and future operating plants. 5 tables.

5761 (EPRI-WS—78-94(Vol.1), pp 11.1-11.16) **Health physics programs to improve outage performance.** Futrell, R.C. (Duke Power Co., Charlotte, NC). Jun 1979.

From Workshop on outage planning and maintenance management; Denver, CO, USA (15 Aug 1978).

Health physics programs are vital to a successful maintenance outage plan. The Duke Power Company program is discussed in view of the present requirement of maintaining occupational radiation exposures as low as reasonably achievable (ALARA) and within regulatory limits. The author discusses the portion of the health physics/ALARA program that is directly involved with outage planning, outage work, and post-outage debriefing. The first phase of planning details job exposures to radiation, exposure reduction techniques, and the cost-effectiveness and impact on the critical path outage schedule. The next stage of planning designates specific tasks and associated doses on a job radiation work permit. Computer programs were designed to estimate job exposures and make task assignments. Costs and benefits of the program are also discussed. 9 figures.

5762 (ESG-DOE—13281) **Reactor safety. Quarterly technical progress report, January-March 1979.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 28 Sep 1979. Contract AT03-76SF74028. 32p. Dep. NTIS, PC A03/MF A01.

Progress in LMFBR safety studies is briefly summarized.

5763 (ESG-DOE—13284) **Reactor safety. Quarterly technical progress report, April-June 1979.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 15 Oct 1979. Contract W-31-109-ENG-38. 25p. Dep. NTIS, PC A02/MF A01.

Progress in LMFBR safety studies is briefly summarized.

5764 (GA-A—15520) **Assessment of a core meltdown in the gas-cooled fast breeder reactor with an upflow core.** Torri, A.; Frank, M.V.; Kang, C. (General Atomic Co., San Diego, CA (USA)). Jul 1979. Contract AT03-76SF71023. 18p. Dep. NTIS, PC A02/MF A01.

This paper discusses the chronological sequence of events and supporting analysis of a postulated total loss of all coolant circulation in the gas-cooled fast breeder reactor (GCFR) with an upflow core. Redundant and diverse cooling systems are provided for decay heat removal, including pressurized natural circulation in the core auxiliary cooling system, which reduce the probability of this postulated event below the range of plant design bases. Nevertheless, this postulated accident has been considered so that the potential for consequence mitigation and containment margin could be investigated. Two distinct phases of the sequence are discussed: (1) the core response to a total loss of forced and natural coolant circulation and (2) the capability of the prestressed concrete reactor vessel (PCRV) to retain molten fuel debris. Specific design features of the GCFR which prevent recriticality and fuel vaporization due to fuel slumping are under investigation. Analytical work has been initiated to determine the potential for consequence mitigation in the PCRV and the containment. Several concepts for postaccident fuel containment have been identified and appear technically feasible.

5765 (HEDL-SA—1712-FP) **Hydrogen ignition and recombination following postulated breeder reactor accidents.** Wierman, R.W.; Muhlestein, L.D. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 9p. (CONF-790816—77). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

Understanding the inherent response of breeder reactors to hydrogen generated during a major accident is important to reactor safety analyses and in evaluating means of controlling hydrogen to safe levels. Experiments have been conducted at the Hanford Engineering Development Laboratory investigating the ignition, burning, and extinguishment of hydrogen jets under conditions similar to those of postulated reactor accidents. Two extensive series of small-scale tests and two large-scale tests have been performed which indicate the conditions necessary for hydrogen jet ignition and extinguishment. The results and conclusions of the test programs are included.

5766 (HEDL-SA—1714-FP) **Aerosol behavior during sodium spray fires and comparison with computer codes.** McCormack, J.D.; Hilliard, R.K.; Postma, A.K.; Owen, R.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 9p. (CONF-790816—79). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The results of sodium spray fires in air in the 850-m^3 CSTF vessel are discussed. During these tests, sodium at 600°C was sprayed downward through commercial nozzles located 16 m above the floor. Test AB3 released 48 kg of sodium spray in 140 seconds with 670-μm MMD drop size and produced a maximum pressure increase of 0.041 MPa and 30 g/m^3 of airborne sodium compounds. Test NT-1 sprayed 82 kg of sodium at 320 μm MMD drop size over 4.7 hours. In both tests, large stable temperature gradients, not predicated by pre-test SPRAY computer code calculations, were observed. Also, post-test estimations of pressure and aerosol concentration made using SPRAY and HAA-3B codes exceeded actual values measured. Thus, the codes conservatively over-predicted the aerosol leakage potential. The experimental data and the SPRAY and HAA-3B code calculations are compared and discussed.

5767 (HEDL-SA—1716-FP) **Sodium concrete reactions.** Colburn, R.P.; Muhlestein, L.D.; Hassberger, J.A.; Mahncke, A.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 11p. (CONF-790816—78). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The data from an extensive series of sodium/concrete reaction tests are presented and mechanisms by which the reactions proceed are analyzed. The results indicate water transport and the resulting sodium/water reaction dominate both the chemical energy release and H_2 generation. A mechanism which explains the limited penetration of concrete observed in most of these tests is proposed.

5768 (HEDL-SA—1741-FP) **Application of optimal estimation techniques to FFTF decay heat removal analysis.** Nutt, W.T.; Additon, S.L.; Parziale, E.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 20 Jul 1979. Contract EY-76-C-14-2170. 11p. (CONF-790816—69). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The verification and adjustment of plant models for decay heat removal analysis using a mix of engineering judgment and formal techniques from control theory are discussed. The formal techniques facilitate dealing with typical test data which are noisy, redundant and do not measure all of the plant model state variables directly. Two pretest examples are presented.

5769 (HEDL-SA—1770) **Radiological analysis of hypothetical accidents by computer.** Martin, H.C.; Hale, J.P. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1979. Contract EY-76-C-14-2170. 14p. (CONF-790816—74). Dep. NTIS, PC A02/MF A01.

From International meeting on fast reactor safety technology; Seattle, WA, USA (19 Aug 1979).

The radiological analyses of extreme hypothetical accidents were performed almost wholly by computer techniques. Major analytical codes used were RIBD, CACECO, SPRAY, HAA, and COMRADEX. This paper describes the analyses, the modeling techniques, and transition programs that edited data output from one

code into a form suitable for input to another. Although not sacrificing a conservative stance, the degree of realism afforded by these analyses shows that the projected consequences could be acceptable. Furthermore the techniques which have been developed are applicable to most LMFBR accident analyses.

5770 (HEDL-SA—1958) **FFTF safety review.** Simpson, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1979. Contract EY-76-C-14-2170. 6p. Dep. NTIS, PC A02/MF A01.

Key features of the FFTF design related to safety are described. The independent safety review process is also discussed.

5771 (IDO—1570-T29) **Summary of LOCE L2-2/L2-3 analysis and LOFT/zion prototypic study.** Linebarger, J.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 40p. Dep. NTIS, PC A03/MF A01.

To date, two 200% double-ended cold leg break experiments have been completed in the LOFT Power Ascension Test Series. LOCE L2-3 was conducted with maximum linear heat generation rate, core fluid temperature rise (ΔT), and system pressure characteristic of the normal operating conditions of a commercial pressurized water reactor (PWR). The thermal behavior of the core in both experiments was dominated by a self-induced cooling mechanism which occurred soon after experiment initiation. The dominance of this phenomena versus current licensing calculation restrictions raises the question of the prototypicality of the LOFT results. The ensuing discussion summarizes both an analysis of the most significant experimental results and a prototypic study of the LOFT results relative to ZION, a commercial PWR. ZION is similar to TROJAN, the commercial PWR to which LOFT was scaled.

5772 (INIS-mf—4492, pp vp) **Statistical considerations in impact modeling.** 1977.

From 4. international conference on structural mechanics in reactor technology; San Francisco, CA, USA (15 Aug 1977).

5773 (NUREG/CR—0470) **Advanced reactor safety research. Quarterly report, July-September 1978.** (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 200p. (SAND—78-2002(Vol.8)). Dep. NTIS, PC A09/MF A01.

Progress in LMFBR safety research is summarized for the following study areas: accident energetics, fuel dynamics, core debris behavior, aerosol source normalization, elevated temperature-design assessment, accident delineation, and test and facility (ACPR upgrade) technology.

5774 (NUREG/CR—0914) **Visual investigation of reactor fuels response to simulated LOF heating conditions, first series.** Cano, G.L.; Ostensen, R.W.; Young, M.F. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 76p. (SAND—79-0940). Dep. NTIS, PC A05/MF A01.

In a loss-of-flow (LOF) accident in an LMFBR, the mode and timescale of disruption of fuel can establish the probability of a subsequent energetic excursion. To investigate these phenomena, in-pile disruption of internal-fission-heated fuel pellets, both fresh UO_2 and preirradiated mixed oxide, was recorded by high speed cinematography. Neither fuel frothing nor dust-cloud breakup occurred under the simulated LOF conditions. Instead massive and very rapid fuel swelling, not predicted by current transient fuel-swelling and gas-release models, occurred. This may be the initial and dominant mode of fuel disruption in a LOF. A new transient fuel-swelling model, FISGAS, has been developed at Sandia.

5775 (NUREG/CR—0927) **Experiment data report for PBF/LOFT Lead Rod Test Series (Tests LLR-S0, -3, -4, -4A, and -5).** Buckland, R.J.; Schwieder, D.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Oct 1979. Contract EY-76-C-07-1570. 377p. (TREE—1272). Dep. NTIS, PC E07/MF E07.

Recorded test data are presented for Tests LLR-S0, LLR-3, LLR-4, LLR-4A, and LLR-5 of the Thermal Fuels Behavior Program PBF/LOFT Lead Rod (LLR) Test Series. This test series, conducted in the Power Burst Facility, was designed to provide a parametric evaluation of the expected mechanical response of the LOFT fuel rods to a loss of coolant event. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to ensure they are reasonable and consistent. These uninterpreted data from the LLR tests are presented in advance of detailed analysis and interpretation.

5776 (NUREG/CR—0964) **Feasibility study for a computerized emergency preparedness simulation facility.** Gerhardstein, L.H.; Schroeder, J.O.; Sandusky, W.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-14-2170. 84p. Dep. NTIS, PC A05/MF A01.

This report details the feasibility of a computerized Emergency Preparedness Simulation Facility (EPSF) for use by the Nuclear Regulatory Commission (NRC). The proposed facility would be designed to provide the NRC and other federal, state, and local government agencies with a capability to formulate, test, and evaluate the Emergency Preparedness Plans (EPP) which local and state agencies have/will establish for use during nuclear emergencies. In cases of any state emergency (including a nuclear emergency), high level state government officials will direct emergency procedures and insure that state and local emergency teams carry out tasks which have been established in their EPP. When an emergency exists, rapid mobilization of emergency teams, efficient communication, and effective coordination of individual team efforts is essential to safety, preservation of property, and overall public welfare. Current EPP evaluation procedures are qualitative in nature and while they do compare emergency drill performance with the EPP, the nature of the drills often does not provide enough realism to actual emergency conditions. Automated simulation of real emergency conditions using modern computer equipment and programming techniques will provide the NRC emergency evaluation teams a simulated environment which closely approximates conditions which would actually exist during a real emergency. In addition, the computer can be used to collect and log performance and event data which will aid the evaluation team in making assessments of the state or local area's EPP and their Emergency Preparedness Teams performance during emergency drills. Overall, a computerized EPSF can improve drill testing and evaluation efficiency, provide approximate emergency condition realism, and improve public awareness of local emergency procedures.

5777 (NUREG/CR—1002) **Uranium and sodium oxide aerosol experiments: NSPP tests 201-203 and tests 301-302, data record report.** Adams, R.E.; Kress, T.S.; Han, J.T.; Parsly, L.F. Jr. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 88p. (ORNL/NUREG/TM—343). Dep. NTIS, PC A05/MF A01.

This data record report summarizes the first three uranium oxide aerosol tests and two preliminary mixed uranium oxide-sodium oxide aerosol tests conducted in the Nuclear Safety Pilot Plant project at Oak Ridge National Laboratory. The goal of the project is to establish the validity (or level of conservatism) of the aerosol behavioral code, HAARM-3, and follow-on codes under development at the Battelle Columbus Laboratories for the US Nuclear Regulatory Commission. Included in the report are descriptions of the five tests, together with tables and graphs summarizing the results.

5778 (NUREG/CR—1023) **Multirod burst test program. Progress report, April-June 1979.** Chapman, R.H. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 77p. (ORNL/NUREG/TM—351). Dep. NTIS, PC A05/MF A01.

Posttest examination and analysis of the B-3 test were essentially completed, and preliminary results are presented. These results confirm indications published earlier that deformation in the B-3 test was indeed greater than observed in the B-1 and B-2 tests. The greater deformation in B-3 is believed to be due to the lower heating rate used in the test (about 10°C/sec, compared with about 30°C/sec for the B-1 and B-2 tests). Shakedown and demonstration tests of the new shroud and fuel-pin simulator temperature control systems were performed in the single-rod test facility with very encouraging performance. Some typical results are presented which indicate that the average temperature of the shroud can be controlled to within about 25°C of the average simulator temperature during both ramp and flat-topped transient heating tests of interest. Conceptual design and tentative test conditions for the B-5 (8 x 8) bundle test were established, and detailed design of the test assembly was nearly completed. Fabrication of the fuel-pin simulators for the test array was initiated. The test is currently scheduled for May 1980.

5779 (NUREG/CR—1092) **Advanced two-phase flow instrumentation program. Quarterly progress report, April-June 1979.** Turnage, K.G.; Davis, C.E. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 27p. (ORNL/NUREG/TM—357). Dep. NTIS, PC A03/MF A01.

Experiments that were conducted in steam-water two-phase flow with a piping segment instrumented for making flow measurements are described. Results obtained with a triple-beam densitometer, a turbine flowmeter, and a drag flowmeter in the steam-water vertical upflow tests are presented. Comparisons between recorded turbine rotor velocities and velocities predicted by three turbine models are made, and two-phase mass flow models, applied to the recorded data, are compared with the mass flow metered into the steam-water system.

5780 (NUREG/CR—1101) **Reports distributed under the NRC Reactor safety research foreign technical exchange program. Vol. VI (January-June 1979).** Queener, D.S. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 91p. (ORNL/NUREG/NSIC—170; TID—3362(Vol.7)). Dep. NTIS, PC A05/MF A01.

Lists of documents exchanged during the first half of 1979 under agreements between the US Nuclear Regulatory Commission's Office of Nuclear Regulatory Research and the governments of France, Federal Republic of Germany, Japan, and the

United Kingdom are presented. These agreements cover safety research on high-temperature gas-cooled reactors (HTGR), light-water reactors, and fast reactors. During this period, the NRC received 43 reports from France, 81 from the Federal Republic of Germany, 17 from Japan, and 84 from the United Kingdom. In return, the NRC sent 163 United States light-water reactor safety research reports to each of these four countries, 50 fast reactor safety research reports to all except France, and 8 HTGR research reports to Japan.

5781 (RE-A—79-013) **Analytical procedure for performing structural analysis of nuclear piping systems subjected to fluid transients.** Morton, D.K. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1979. Contract EY-76-C-07-1570. 160p. Dep. NTIS, PC E07/MF E01.

An analytical procedure is formulated for the purpose of predicting the structural consequences of various fluid transients in nuclear piping systems. For demonstration purposes, this procedure is utilized to structurally analyze two representative nuclear piping systems subjected to different fluid transients. All procedure details and demonstration problem results are included in the appendices.

5782 (RE-A—79-044) **State-of-the-art literature review of water hammer.** Watkins, J.C.; Berry, R.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1979. Contract EY-76-C-07-1570. 116p. Dep. NTIS, PC A06/MF A01.

A state-of-the art review of literature pertinent to fluid transients (water hammer) was undertaken for the Nuclear Regulatory Commission. This review is part of the ongoing water hammer studies being performed by EG and G Idaho, Inc., to further the understanding of the water hammer phenomenon, to more accurately identify its causes and to more accurately predict its effects. A scenario of various fluid transients is presented, followed by a review of research and testing of various phenomena wich affect the severity of the transient. Finally, numerical simulation techniques of such transients as well as numerous computer codes which could be applied to such transients, are discussed.

5783 (SAND—79-0956C) **Boolean approach to common event analysis.** Worrell, R.B.; Stack, D.W. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 7p. (CONF-800103—1). Dep. NTIS, PC A02/MF A01.

From Reliability and maintainability symposium; San Francisco, CA, USA (22 Jan 1980).

Although different phenomena may be involved, the problem that must be solved for each kind of common event analysis is essentially the same: to determine the effect of common events on the behavior of a system. A Boolean approach to the problem is set forth. Because of the large equations that arise, processing must be done by computers. Vital location analysis is a particular kind of common event analysis that is used to study ways to prevent the sabotage of nuclear reactors. (RWR)

5784 (UCID—18135-79-2) **US NRC/LLL liaison with the Federal Republic of Germany for the GKSS-PSS steam condensation tests. Progress report No. 2.** Holman, G.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Sep 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

This second progress report for the USNRC/LLL liaison program with the Federal Republic of Germany regarding boiling water reactor containment multivent steam condensation tests being conducted by GKSS addresses program activity during the period of July-August, 1979. During this period, the first digital data, video tapes, and complete report for test VM1 were received, together with various computer software used by GKSS for data reduction. Document handling procedures were finalized in order to protect the proprietary nature of informaion received from GKSS and several translations were obtained.

5785 (UCID—18315) **ARAC feasibility study for the NRC Phase I: final report.** Rosen, L.C.; Orphan, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1979. Contract W-7405-ENG-48. 56p. Dep. NTIS, PC A04/MF A01.

The feasibility of implementing ARAC (Atmospheric Release Advisory Capability) services in a particular nuclear power plant is examined. The criteria for selecting Rancho Seco are discussed and the physical, meteorological and procedural factors related to the plant are assessed. The potential benefits and limitations of implementing ARAC at Rancho Seco are analyzed. The costs of employing the system at the nuclear power plant are given for alternative plans. A training and familiarization program is outlined.

5786 (UCRL—15116) **Fluid-structure interaction in BWR suppression pool systems. Final report.** Nickell, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

The discharge of safety relief valves or a severe loss-of-coolant event in a boiling-water-cooled reactor steam supply system triggers a complex pressure suppression system that is based upon sub-surface steam condensation in large pools of water. The physical problems fall into two categories. The first is referred to as vent clearing and describes the process of expelling non-condensables from the system prior to steam flow. The second category covers a variety of phenomena related to the transient overexpansion of a condensable volume and the subsequent inertially-driven volume decrease. The dynamic loading of either event, depending upon fluid-structural design parameters, can be of concern in safety analysis. This report describes the development of a method for calculating the loads and the structural response for both types of problems. The method is embedded in a computer code, called PELE-IC, that couples a two-dimensional, incompressible eulerian fluid algorithm to a finite element shell algorithm. The fluid physics is based upon the SOLA algorithm, which provideds a trial velocity field using the Navier-Stokes equations that is subsequently corrected iteratively so that incompressibility, fluid-structure interface compatibility, and boundary conditions are satisfied. These fluid and fluid-structure algorithms have been extensively verified through calculations of known solutions from the classical literature, and by comparison to air and steam blowdown experiments.

5787 (UCRL—52717) **Measurements, error analyses, and calculations of water and steam individual mass flow rates, velocities, and related flow parameters obtained from single-phase and two-phase prototype tests of the PKL instrumented spool pieces for the US NRC-RSR 3-D program.** Stein, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Sep 1979. Contract W-7405-ENG-48. 109p. Dep. NTIS, PC A06/MF A01.

The operation of the emergency core cooling system and its related steam-binding problems in pressurized water reactors are the subject of a cooperative study by the United States, Germany, and Japan. Lawrence Livermore Laboratory and EG and G, Inc., San Ramon Operations, are responsible for the design, hardware, and software of the 80.8-mm and 113-mm spool piece measurement systems for the German Primarkreislauf (PKL) Test Facility at Kraftwerk Union in Erlangen, West Germany. Four PKL spool pieces each containing a flow turbine, drag screen, three-beam densitometer, and pressure and temperature probes were constructed and tested to measure single-phase and two-phase steam and water flow parameters. Individual phase velocities, mass flow rates, and densities were calculated from the analytical relationships presented. These calculated and measured parameters were compared to those parameters determined from the test facility instrumentation at Wyle Laboratories. Error analyses were performed, and individual test results were presented for both horizontal and vertical flows. The various flow regimes tested included annular mist, slug, froth, stratified wavy, and homogeneous flow of water or superheated steam.

5788 (WARD-CR—94000-3) **Core restraint development. Quarterly progress report for period ending May 31, 1979.** Sirota, B.B. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Oct 1979. Contract AM02-76CH94000. 77p. AT.

This quarterly progress report covers the period from March 1, 1979 to May 31, 1979. Processing of compaction data results from nominal and low friction tests on a straight 7 row core was continued. The 14 row straight core testing was focused on specialized compaction tests and assembly characterization measurements during this period. A comparison of irradiation induced free-bow shapes indicated that the NUBOW-3D solution is swelling dominated relative to the ANSYS solution. The first application of a benchmark problem set to be used for core restraint evaluation of irradiation creep and swelling equations was studied for a variety of cases.

5789 **Effect of solid fission products and dislocations on oxide fuel element behavior in fast overpower transients.** Chien, S.H.; Wazzan, A.R.; Okrent, D. (Univ. of California, Los Angeles). *Nucl. Technol.;* **46**: No. 1, 110-126(Nov 1979).

A simplistic analytical treatment is given of the effects of dislocations and solid fission products on the behavior of fission gas in oxide fuel elements during fast thermal transients. The analysis is coupled with the BUBE code (a code that models equilibrium and nonequilibrium fission gas bubbles in thermal transients) and used to analyze two Transient Reactor Test Facility transients. The results suggest that the effect of dislocations on swelling and fission gas release is negligible, but that the effect of solid fission products is important.

5790 **Training in radiation protection given to personnel of nuclear power plants.** Brosson, M.; Lambinon, Y. (Electricite de France, 75 - Paris. Service de la Production Thermique). pp 1363-1366 of Proceedings of the 4. International congress of the International Radiation Protection Association. Paris, 24-30 April 1977. Vol. 4. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977). (In French)

From 4. congress of the International Radiation Protection Agency; Paris, France (24 Apr 1977).

See CONF-770409—. Available from M. Gilbert Bresson, General Secretary IRPA, B.P. No. 33, 92260 Fontenay-aux-Roses, France.

Any action undertaken in technical training must aim at mastering the know-how appropriate to the work to be done. To develop a training program in radiation protection intended for persons who work in radioactive areas it is necessary to analyze the tasks corresponding to the work to be done then to install the means required to implement them. Evaluating the hazards (second stage training) is the sole responsibility of those in charge of work safety assisted where necessary by a specialist on specific hazard (specialized training). But all the staff, knowing the risks involved, must know how to protect themselves (first-stage training). Stage I and 2 trainings are given in site and call for specific teaching methods. It was necessary to create a further training course for them known as stage 3 training to prepare the instructors.

ACCIDENT LIABILITY

5791 Price-Anderson Act and nuclear insurance. Long, J.D. (Indiana Univ., Bloomington); Long, D.P. *Insur. Law J.*; No. 678, 367-375(Jul 1979).

The nuclear incident at Three Mile Island has served to intensify debate about elimination of the federal limit on liability of utilities (and others) for operation of private nuclear reactions and about elimination of possible federal indemnification of utilities (or others) for claims paid in nuclear incidents. Not all those who debate these issues appear to be fully informed about the present nuclear liability and insurance system. This paper provides a brief description of the Price-Anderson Act, as amended, and of the operation of the nuclear insurance pools. It also includes a comment on the recent federal district court award against the Kerr-McGee Corporation.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 5946

COMPRESSED GAS

5792 (PNL—3191) **Economics of compressed air energy storage employing thermal energy storage.** Schulte, S.C.; Reilly, R.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 34p. Dep. NTIS, PC A03/MF A01.

The approach taken in this study is to adopt system design and capital cost estimates from three independent CAES studies (eight total designs) and, by supplying a common set of fuel/energy costs and economic assumptions in conjunction with a common methodology, to arrive at a series of levelized energy costs over the system's lifetime. In addition, some analyses are provided to gauge the sensitivity of these levelized energy costs to fuel and compression energy costs and to system capacity factors. The systems chosen for comparison are of four generic types: conventional CAES, hybrid CAES, adiabatic CAES, and an advanced-design gas turbine (GT). In conventional CAES systems the heat of compression generated during the storage operation is rejected to the environment, and later, during the energy-generation phase, turbine fuel must be burned to reheat the compressed air. In the hybrid systems some of the heat of compression is stored and reapplied later during the generation phase, thereby reducing turbine fuel requirements. The adiabatic systems store adequate thermal energy to eliminate the need for turbine fuel entirely. The gas turbine is included within the report for comparison purposes; it is an advanced-design turbine, one that is expected to be available by 1985.

5793 (PNL-SA—7949) **Economics of thermal energy storage for compressed air energy storage systems.** Schulte, S.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 8p. Dep. NTIS, PC A02/MF A01.

The costs of compressed air energy storage (CAES) systems utilizing thermal energy storage are compared with the costs of conventional CAES systems and combustion gas turbine systems. Comparisons are made on the basis of system energy cost levelized over system operating lifetime (mills/kWh). The comparison was performed by Pacific Northwest Laboratory for the Department of Energy using information from reference studies by the Massachusetts Institute of Technology, Central Electricity Generating Board and Knutsen Research Services. System energy costs were estimated using information from three reference CAES/thermal energy storage studies, a recent PNL research effort, and the EPRI Technical Assessment Guide. Capital investment cost estimates and system operating requirements were obtained from the reference studies. Current turbine fuel and compression energy prices were obtained from a July 1979 PNL research effort. Economic and financial input assumptions and a discounted cash flow-required revenue computational methodology were taken from the Technical Assessment Guide. Use of such a normalization procedure results in system energy cost estimates that are both realistic and comparable. Two principal conclusions resulted from the study. First, given today's fuel prices and the expected fuel prices in the 1980's, conventional CAES systems yield lower energy cost estimates than combustion gas turbine systems. Second, thermal energy system storage/adiabatic CAES systems yield equivalent and, in some instances, slightly lower energy cost estimates than conventional CAES systems while requiring considerably less turbine fuel oil.

FLYWHEELS

5794 (UCRL—83554) **Composite-laminate flywheel-rotor development program.** Kulkarni, S.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1979. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

The composite-laminate flywheel program is being conducted at the Lawrence Livermore Laboratory (LLL) (tapered thickness Stodola rotor concept) and at the General Electric Company (alphaply constant-thickness rotor concept). The major thrust of the FY 1979 LLL program was directed towards identifying the pacing issues and implementing the steps undertaken to improve the performance of the rotor. To that end, the following tasks were initiated: (1) redesigning the Stodola rotor to increase the energy density; (2) testing laminate coupons to establish the degree of strength anisotropy of various quasi-isotropic laminates; (3) spin testing of constant-thickness composite-laminate rotors to establish a relationship between design data and failure speed; (4) developing a matched-metal-die compression-molding process to fabricate thick, high-fiber volume, low-void-content composite panels; and (5) exploring the feasibility of manufacturing low-cost rotors from structural sheet-molding compounds. The progress to date in each of these areas is reported.

THERMAL

REFER ALSO TO CITATION(S) 5793

5795 (CONS—5113-T4) **Thermal energy storage application areas.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). Mar 1979. Contract EC-77-C-01-5113. 105p. Dep. NTIS, PC A06/MF A01.

The use of thermal energy storage in the areas of building heating and cooling, recovery of industrial process and waste heat, solar power generation, and off-peak energy storage and load management in electric utilities is reviewed. (TFD)

5796 (LBL—9834) **Review of current aquifer thermal energy storage projects.** Tsang, C.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 23p. (CONF-790515—5). Dep. NTIS, PC A02/MF A01.

From International assembly on energy storage; Dubrovnik, Yugoslavia (27 May 1979).

The report reviews the current projects in their various stages of progress. They are somewhat arbitrarily grouped into three categories: (a) field experiments; (b) theoretical and modeling studies; and (c) feasibility studies. After a description of these projects, the key problems which need to be solved in the field of ATES are discussed. These key problems are proposed as areas where efforts should be directed in order to make ATES a technically feasible and economically viable means of energy storage.

5797 (ORO—5217-8) **Macro-encapsulation of heat storage phase-change materials for use in residential buildings. Final report, September 29, 1976-September 6, 1978.** Lane, G.A.; Kott, A.C.; Warner, G.L.; Hartwick, P.B.; Rossow, H.E. (Dow Chemical Co., Midland, MI (USA)). Nov 1978. Contract EY-76-C-05-5217. 168p. Dep. NTIS, PC A08/MF A01.

Objectives are to assess the feasibility of macro-encapsulated PCM's for residential solar systems, to develop and evaluate such materials. Encapsulant materials under consideration are multilayer flexible plastic films, steel cans, and plastic bottles. Studies were done in a storage test unit on: $CaCl_2.6H_2O$ encapsulated in polyethylene bottles, $Mg(NO_3)_26H_2O$ in steel cans, $Mg(NO_3)_26H_2O/NH_4NO_3$ eutectic encapsulated in flexible plastic film packages, NH_4Br/urea eutectic in polypropylene bottles, and a combined bed of $CaCl_2.6H_2O$ and $Mg(NO_3)_26H_2O/NH_4NO_3$ eutectic. In most cases, charge and discharge capacities in excess of 90% of theory were obtained. Several designs using encapsulated PCM were analyzed, one was selected, and preliminary designs were developed for a demonstration project.

BATTERIES

5798 (CONS—3885-T1) **Battery technology - an assessment of the state of the art.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). 27 Mar 1978. Contract EX-76-C-10-3885. 64p. Dep. NTIS, PC A04/MF A01.

A state-of-the-art battery survey and data verification process were conducted with battery manufacturers and organizations involved in battery technology research and development. This report addresses those major battery technologies which were identified as either being developed or explored as potential candidates for major energy storage applications in electric utilities or transportation as well as for future operations with solar or wind energy systems. Near- and far-term battery systems, current data and opinions, and developments in both US and foreign battery technology for utility load leveling and electric vehicles are discussed. Background information and the scope of the report are given first. Then basic data for each battery type are summarized; a general discussion of other potential battery systems is also included. A comparative summary of battery cost and performance is presented; actual battery capabilities are discussed relative to the general requirements of electric utility load leveling and transportation applications. The current status of the scarce materials and environmental and safety problems related to battery technology is presented. The overall status of the current R and D programs and expected progress toward commercialization are discussed; the roles of competing technologies in two major markets for battery technology are addressed. General observations, conclusions, and recommendations are given. 9 figures, 25 tables. (RWR)

DESIGN AND DEVELOPMENT

5799 (MTR—8026) **Status of the DOE battery and electrochemical technology program.** Roberts, R. (Mitre Corp., McLean, VA (USA)). Sep 1979. Contract ET-78-C-01-3295. 177p. Dep. NTIS, PC A09/MF A01.

This report reviews the status of the Department of Energy program on Electrochemical Storage systems as of June 1978. It is based on material presented at the Second Annual Battery and Electrochemical Technology Conference. Emphasis is placed on secondary batteries; however, selected mechanically rechargeable batteries are included. Batteries in the research, development and demonstration phases are included: near term - lead-acid, nickel/iron, nickel/zinc; advanced - lithium/metal sulfide, sodium/sulfur, zinc/chlorine; research and development - metal/air, hydrogen/chlorine, zinc/bromine, redox, organic electrolytes. Supporting research on the morphology of active materials, cell performance modeling, new battery materials, and other topics are included. Studies related to energy conservation and alternative processes in electrochemical industry are reviewed. The potential contributions of the battery program to the various DOE missions supported - electric vehicles, photovoltaic systems, distributed electrical energy systems and energy conservation in industry - are discussed. 43 figures, 21 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 5888

5800 **In situ self cross-linking of polyvinyl alcohol battery separators.** Philipp, W.H.; Hsu, L.C.; Sheibley, D.W. (to National Aeronautics and Space Administration). US Patent 4,154,912. 15 May 1979. Filed date 19 Apr 1978. 6p.

A battery separator is produced from a polyvinyl alcohol sheet structure which is subjected to a self-cross-linking process in situ by selective oxidation of the 1,2 diol units present in the polyvinyl alcohol sheet structure. The 1,2 diol units are cleaved to form aldehyde end groups which subsequently cross-link through acetalization of the 1,3 diol units of the polyvinyl alcohol. Selective oxidation is achieved by use of a solution of a suitable oxidizing agent such as periodic acid or lead tetraacetate.

APPLICATIONS

REFER ALSO TO CITATION(S) 5485

ENERGY MANAGEMENT AND POLICY

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 5816, 5817, 5858, 5864, 5928, 5935

5801 (DOE/EIA—6548-1(Suppl.)) **Revisions to the Mid-term Energy Market Model relating to natural gas regulation, advanced technologies, coal demand and dynamics. Supplement to the integrating model of the Project Independence Evaluation System.** Barcella, M.L.; Vollmer, S. (Logistics Management Inst., Washington, DC (USA)). 5 Apr 1979. Contract EI-78-C-01-6548. 60p. Dep. NTIS, PC A04/MF A01.

This report consists of four technical memoranda documenting four major modeling improvements which were made to the DOE Mid-term Energy Market Model (MEMM) in late 1978 and early 1979 during the preparation of the EIA's Annual Report to Congress, 1978. The changes, and the subjects of the memoranda, include: (1) extensive revision of the modeling of natural gas regulation to reflect provisions of the Natural Gas Policy Act of 1978; (2) more sophisticated treatment of advanced energy technologies (oil shale, coal conversion, solar/geothermal, solid waste conversion, enhanced oil recovery, and enhanced gas recovery); (3) more detailed treatment of the demand for coal of various sulfur contents and the costs associated with the use of such coal, particularly in the electric utility sector; and (4) changes in the modeling of dynamics to accommodate the extension of the model to 1995 and the more detailed modeling of coal-fired utility plants.

5802 (DOE/EIA—8558-1) **Integrating model of the Project Independence Evaluation System. Volume 1. Executive summary.** Shaw, M.L.; Hutzler, M.J. (Logistics Management Inst., Washington, DC (USA)). Apr 1979. Contract EM-77-C-01-8558. 52p. Dep. NTIS, PC A04/MF A01.

This report is Volume I of a six-volume series documenting the Integrating Model of the Project Independence Evaluation System (PIES) as it existed on January 1, 1978. It offers a review of entire PIES system, including the basic components of the Integrating Model, which are described in detail in Volume IV of this series. In particular, this volume addresses the problem that PIES solves and the major features and applications of PIES.

5803 (DOE/EIA—8558-6/2) **Integrating model of the Project Independence Evaluation System. Volume VI. Data documentation. Part II.** Allen, B.J. (Logistics Management Inst., Washington, DC (USA)). Feb 1979. Contract EM-77-C-01-8558. 281p. Dep. NTIS, PC A13/MF A01.

This documentation describes the PIES Integrating Model as it existed on January 1, 1978. This Volume VI of six volumes is data documentation, containing the standard table data used for the Administrator's Report at the beginning of 1978, along with the primary data sources and the office responsible. It also contains a copy of a PIES Integrating Model Report with a description of its content. Following an overview chapter, Chapter II, Supply and Demand Data Tables and Sources for the Mid-range Scenario for Target Years 1985 and 1990, data on demand, price, and elasticity; coal; imports; oil and gas; refineries; synthetics, shale, and solar/geothermal; transportation; and utilities are presented. The following data on alternate scenarios are discussed: low and high demand; low and high oil and gas supply; refinery and oil and gas data assuming a 5% annual increase in real world oil prices. Chapter IV describes the solution output obtained from an execution of PIES.

5804 (LA-UR—79-2895) **Sensitivity analysis and a national energy model example.** McKay, M.D. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 24p. (CONF-791016—4). Dep. NTIS, PC A02/MF A01.

From 1979 DOE statistical symposium; Gatlinburg, TN, USA (24 Oct 1979).

Sensitivity analysis, a study of changes in a model output produced by varying model inputs, is much more than estimating partial derivatives. As a part of model evaluation, it is an exploratory process directed towards finding out how and why a model responds to different values of inputs. When viewed as a data analysis problem, the intent of sensitivity analysis is to make an inference about a model based on a sample of observations generated from the space of input values. The validity of the inferences is tied closely to the laws, or assumptions, relating the observations (data) and the model.

5805 (LBL—8772) **Using DOE-2 at Lawrence Berkeley Laboratory.** (Jewson Enterprises, Menlo Park, CA (USA)). Sep 1979. Contract W-7405-ENG-48. 55p. Dep. NTIS, PC A04/MF A01.

The manual provides directions for the DOE-2 user to run DOE-2 and its utility programs at LBL. After basic instructions are provided in Section 1, Section 2 provides storage and retrieving information for DOE-2 data for re-use. Additional information is provided on using interactive terminals; preparing your own weather file for DOE-2 use; and obtaining response factor calculations.

5806 (ORAU/IEA—79-11(R)) **Energy accounting for solar and alternative energy sources.** Devine, W.D. Jr. (Institute for Energy Analysis, Oak Ridge, TN (USA)). Jun 1979. Contract EY-76-C-05-0033. 76p. Dep. NTIS, PC A05/MF A01.

Several inadequacies in present energy-accounting practices have become apparent. These shortcomings in energy data collection

and display are perhaps of minor consequence in an economy like that of today in which most end-use services are provided via fossil fuels and electricity. However, the emergence of a wide variety of alternative technologies that might be used to provide these same services suggests that present accounting practices be reexamined and a more appropriate system devised. This paper proposes an energy-accounting framework based upon the actual services provided to end users. An energy service is a measure of the service actually provided to ultimate consumers by their own use of energy, quantified, for example, using units of work or of heat at various temperatures. Fifteen categories of energy service are described, and some of their characteristics are identified. The proposed energy-accounting framework consists of two matrices - an energy-service matrix and an energy-carrier matrix. The energy-service matrix displays quantities of energy services provided in various ways as well as quantities of energy carriers used to provide energy services. The energy-carrier matrix displays quantities of energy carriers used to produce and distribute energy carriers to ultimate consumers. This accounting framework is illustrated with 1972 energy data for the United States, and several observations are made relative to long-range solar energy research and development policy.

5807 (ORAU/IEA—79-13(R)) **Comparative analysis of global energy models.** Allen, E.L.; Edmonds, J.A.; Kuenne, R.E. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Jun 1979. Contract EY-76-C-05-0033. 49p. Dep. NTIS, PC A03/MF A01.

This study is a comparative analysis of seven leading models concerned with forecasts of worldwide energy demand through 1985. There are wide variations among the models' projections of non-Communist world demands for OPEC petroleum in 1985. This variation is attributed to two broad causes, economic growth and energy utilization rates. The paper concludes that differences in economic growth assumptions were less important than energy utilization rate assumptions in explaining disparities among energy demand forecasts. The heterogeneous modeling methodologies prevent a further disaggregation of causation into more specific components such as level of energy prices, price elasticities, conservation, rates of technological advance, demographic changes, and income effects. Differential petroleum demand projections are also analyzed. Variation in energy projections is attributed to economic growth, energy utilization, and interfuel substitution possibilities. The last category proves to be the largest single source of differences. It is also concluded that supply assumptions accounted for almost none of the differences among projections.

5808 (ORAU/IEA—79-16(0)) **Limits to energy modeling.** Weinberg, A.M. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Sep 1979. Contract EY-76-C-05-0033. 19p. Dep. NTIS, PC A02/MF A01.

Energy demand models seek to determine the response of consumers to change in price of energy. Such models have intrinsic limitations; energy policies based on their predictions are correspondingly inadequate. One way of finessing such uncertainty is to adopt technological fixes that do not depend on decisions by millions of consumers. It is pointed out that the Carter plan to produce 2.5 million barrels of synfuel by 1990 is such a technological fix. It avoids the uncertainties inherent in policies that depend on predicted responses of consumers to change in price of energy. (This paper is a modified version of ORAU/IEA-79-5(0), Energy Policy and Mathematics).

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 5857, 5905, 5914, 5932

5809 (DOE/EIA—0102/T1) **State earnings analysis for the Administrator's Annual Report, analysis memorandum.** Sandoval, A.D.; Schnapp, R.M.; Wenger, R.S. (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 44p. Dep. NTIS, PC A03/MF A01.

The 1978 EIA Annual Report to Congress, Volume II, considers a series of energy projections that incorporate different assumptions about energy resource availability, economic growth, and the price of imported oil. A version of the Regional Earnings Impact System (REIS) is used to estimate the 1985 State earnings associated with five of those energy projections. The projections are: Series A: high energy resources and high economic growth; Series B: low energy resources and high economic growth; Series C: mid-level energy resources and economics growth; Series D: high energy resources and low economic growth; and Series E: low energy resources and low economic growth. The series assume a $13.00 constant real price for imported oil. Besides depicting the obvious relationship between earnings in the energy-resource states and the assumed level of energy production, the REIS results show that earnings in the industrial states, particularly in the Midwest and in New England, vary the most under different projections. In contrast, earnings in the predominantly agricultural states and in the District of Columbia vary little between projections.

5810 (DOE/IR—10233) **Plan for developing a comprehensive energy manpower information system.** (Kramer Associates, Inc., Washington, DC (USA)). Sep 1979. Contract EU-78-C-01-6647. 169p. Dep. NTIS, PC A08/MF A01.

The report is designed to make a beginning in broadening the scope of the comprehensive manpower information system for energy research, development, and demonstration, so that it could cover all manpower related to energy. It develops a plan for this extension, including determining which taxonomies require change, specifying the subsequent stages involved in expanding CEMIS to all energy manpower, and providing the basis for cost estimates for this work. The report is organized as follows: The analytical rationale is described in Chapter II. Chapter III reviews the status of manpower data in a number of energy sectors, notes limitations and gaps in the data, and discusses improvements and additions that should be made. The scope and structure of CEMIS are laid out in Chapter IV, with particular reference to the development of analytical processes, and of analytical linking functions between bodies of data, and a description of their application in anticipating the employment impact of energy changes. The appropriate steps recommended for the further development of CEMIS are described in Chapter V.

5811 (ID—80-2) **Prospects for cooperation and trade of energy resources between the United States and Canada.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 8 Nov 1979. 41p. General Accounting Office, 441 G St., NW, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

The future of the United States and Canada is closely linked by these countries' economic, security, and political interdependencies which have expanded into the area of energy. Canada now supplies the United States with about 5% of its total gas supply and has the potential for additional exports. Its conventional oil reserves are relatively small and are not seen as the solution to the continuing US dependence on OPEC. This year marked an agreement between the two countries for joint cooperation in dealing with mutual energy problems. Because of these close relations, initiatives taken by Canada to manage its energy resources may be of interest to the Congress and the executive branch in connection with US energy plans.

5812 (LA-UR—79-3259) **Federal mineral-lease-bidding data bases versus the real world and vice versa.** Lohrenz, J.; Waller, R.A. (Geological Survey, Denver, CO (USA). Conservation Div.; Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 34p. (CONF-791214—1). Dep. NTIS, PC A03/MF A01.

From Conference on auctions and competitive bidding; Mt. Kisco, NY, USA (6 Dec 1979).

From the vantage point of builders and operators of Federal mineral-lease-bidding data bases, users are addressed. Users are a polyglot lot of empiricists, mechanists, and theorists. The users' perfect data base would contain all data needed to examine all bidding theories and predict bidders' behavior using the theories. That ideal data base has not been attained. However, even the richly flawed history of these data bases leads one to the not particularly prescient notion that users, with omnipresent complaints about errors in and lack of data, will keep the data bases functioning by using them.

5813 (PB—291036) **Low-income families and high energy costs: an economic study.** Hudder, J.J. (Syracuse Research Corp., NY (USA). Energy Research Center). Sep 1978. 43p. NTIS PC A03/MF A01.

Presented are the effects of energy prices on the poor, discussed against the background of the Federal poverty index, aggregate characteristics of who are the poor, and energy consumption on the part of all Americans. Data are presented for CSA's Region III in particular (Maryland, Pennsylvania, Virginia, and West Virginia).

5814 (SERI/TR—53-155) **Public opinion about energy: a literature review.** Farhar, B.C.; Weis, P.; Unseld, C.T.; Burns, B.A. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1979. Contract EG-77-C-01-4042. 450p. Dep. NTIS, PC A19/MF A01.

A review and analysis of 115 surveys of the general population between 1973 and 1978 (before the Three Mile Island accident. sudden gasoline price increases, and spot gasoline shortages) are presented. The survey data are organized and analyzed according to a set of categories described in Chapter 2. The public's definition of the energy situation is the focus of Chapter 3. Chapter 4 describes public opinion concerning energy conservation pertaining to transportation and domestic energy use -- whether it is efficacious, how knowledgeable people are about conservation, whether they favor it, and whether they engage in it. Findings on the solar energy alternative are described in Chapter 5. Public opinion concerning more conventional sources of energy -- oil and natural gas, coal, and

nuclear energy -- are discussed in Chapter 6. In Chapter 7, a summary of analytical findings by 10 major sociodemographic characteristics is presented. Chapter 8 describes analytical findings using various social-psychological variables. A summary is presented in Chapter 9.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 5494, 6171, 6172, 6184

5815 (PB—290162) **National Emissions Data Systems (NEDS) fuel use report (1975). Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Apr 1978. 130p. NTIS PC A07/MF A01.

This report summarizes annual estimates of total consumption of major fuels such as coal, fuel oil, natural gas, gasoline, and diesel fuel. Estimates of the consumption of a number of other comparatively minor fuels are also included. The data are distributed according to major categories of air pollutant emissions sources and are reported for the nation as a whole and for individual states, territories, and the District of Columbia. (Portions of this document are not fully legible)

5816 (SAN—115/136-2) **Long term impact of atmospheric carbon dioxide on climate. Technical report JSR-78-07.** MacDonald, G.; Abarbanel, H.; Carruthers, P. (SRI International, Arlington, VA (USA)). Apr 1979. Contract EY-76-C-03-0115 P.A. 136. 184p. Dep. NTIS, PC A09/MF A01.

If the current growth rate in the use of fossil fuels continues at 4.3% per year, then the CO_2 concentration in the atmosphere can be expected to double by about 2035 provided the current partition of CO_2 between the atmosphere, biosphere, and oceans is maintained as is the current mix of fuels. Slower rates of anticipated growth of energy use lead to a doubling of the carbon content of the atmosphere sometime in the period 2040 to 2060. This report addresses the questions of the sources of atmospheric CO_2; considers distribution of the present CO_2 among the atmospheric, oceanic, and biospheric reservoir; and assesses the impact on climate as reflected by the average ground temperature at each latitude of significant increases in atmospheric CO_2. An analytic model of the atmosphere was constructed (JASON Climate Model). Calculation with this zonally averaged model shows an increase of average surface temperature of 2.4° for a doubling of CO_2. The equatorial temperature increases by 0.7°K, while the poles warm up by 10 to 12°K. The warming of climate will not necessarily lead to improved living conditions everywhere. Changes in sea level, in agricultural productivity, and in water availability can be anticipated, but the dimensions of their economic, political, or social consequences can not.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 5812, 5933

5817 (EPRI-EA—1147) **Determining the feasibility of incorporating water resource constraints into energy models. Final report.** Buras, N. (Stanford Univ., CA (USA). Dept. of Operations Research). Aug 1979. 132p. Dep. NTIS, PC A07/MF A01.

Development of energy sources and generation of electric power require substantial amounts of water. The water is necessary as process water in the production of synthetic fuels, and as cooling water in almost all activities related to the development of energy resources and in thermal electric power plants. Yet existing energy-economy models do not explicitly take account of the availability of water resources for energy-related activities. This project expresses, in a general form, the availability of regional water resources and determines the feasibility of integrating these availabilities into energy models. Following reviews of water resources data bases, of technologies involved in energy development, and of energy models with regional disaggregation, two models are used for the study of this integration: the Regional Energy System Optimization Model (RESOM), currently under development at the Brookhaven National Laboratory, and the Energy Policy Model (EPM), developed at the Lawrence Livermore Laboratory. Water resources constraints are introduced in these models, and exploratory computer runs using demonstration scenarios are made. The test scenarios assumed that nonenergy users would make increasing demands upon regional water resources, leaving limited amounts of increasingly more expensive water for energy activities. The results of the exploratory runs demonstrate the feasibility of integrating water resources availabilities and water consumption data into energy-economy models.

5818 **Timetable for state agency actions: the mine development process.** Springman, R. Madison, WI; Wisconsin Office of State Planning and Energy (1977). 74p. (NP—23933).

Mining developments require state action to meet the challenges brought by these developments. A Mining Subcommittee was organized in 1976 in Wisconsin to ensure that state agencies bring about maximum economic benefit and minimal environmental degradation and social disruption from mining. This report provides planning and decision making guidance to regulatory and community assistance agencies responsible for metallic mining and its impacts.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 5825, 5826

5819 (NMEI—78-1136) **New Mexico energy research and development projects: June 1979 Energy Registry update.** Cole, R.W. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Inst.). Aug 1979. 148p. Univ. of New Mexico, New Mexico Energy Institute, Albuquerque, NM.

The research projects reported are categorized under two major classifications as follows: energy sources (coal, oil and gas, nuclear, geothermal, solar, wind, tidal power, hydrogen, plant and animal materials, waste products) and general (power generation, transmission, distribution, and storage; power utilization; energy conservation; socioeconomic and legal aspects; environmental and health effects; water resources; heat pipe technology). Information given for each project includes the project title, research facilities, principal investigator, sponsor, funding agency, duration of project, project description or abstract. (MCW)

5820 (NP—24172) **Program for energy research and technologies, 1977-1980. Annual report 1978 on new sources of energy.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Project Management for Energy Research (PLE)). 1978. 347p. Dep. NTIS (US Sales Only), PC A15/MF A01.

Supported projects in the Program for Energy Research and Technologies 1977-1980 of the FRG, excluding projects relating to nuclear energy and fusion research are reviewed. The report comprises: as forewords, the relevant passages from the Program for Energy Research and Technologies, 1977-1978, brought up to date in certain passages and supplemented with explanatory diagrams and illustrations, and inserted at the beginning of the descriptions of the individual supported projects within the 3 subprograms; a list of supported projects according to the position a the end of 1978. This is broken down according to the three subprograms: efficient uses of energy in application and in secondary energy; coal and other fossil sources of primary energy; and new sources of energy. These form the classification headings and are reproduced with a subject area subdivision. The individual projects have been assigned a program number. Descriptions of the individual sponsored projects are shown in numerical sequence of the program numbers in the project list and divided according to the three subprograms.

5821 (SAN—1484-2) **Institutional support for the Utah Consortium for Energy Research and Education. Annual report.** (Brigham Young Univ., Provo, UT (USA); Utah Univ., Salt Lake City (USA); Utah State Univ., Logan (USA)). Jun 1979. Contract EE-77-S-03-1484. 76p. Dep. NTIS, PC A05/MF A01.

The Utah Consortium for Energy Research and Education is made up of three colleges and universities in Utah. The scope of the Consortium plan is the marshalling of the academic research resources, as well as the appropriate non-academic resources within Utah to pursue, as appropriate, energy-related research activities. The heart of this effort has been the institutional contract between DOE and the University of Utah, acting as fiscal agent for the Consortium. Sixteen programs are currently being funded, but only ten of the projects are described in this report. Three projects are on fission/fusion; three on environment and safety; four on fossil energy; three on basic energy sciences; one each on conservation, geothermal, and solar.

5822 (WAOENG—79-4) **Current energy research and development in Washington State.** Alexander, G.; Lee, G. (comps.). (Washington State Energy Office, Olympia (USA)). Jul 1979. 44p. Washington State Energy Office, Olympia.

The inventory of energy-related research, development, and demonstration projects in Washington facilitates the dissemination of new energy data and information to researchers, policy makers, and citizens. The information was collected via survey forms mailed to known contractors, research organizations, and colleges and universities during April 1979. Directories and reports were scanned for projects. Entries are arranged by broad subject categories (biomass, solar energy, geothermal, OTEC, fossil fuels, nuclear energy, electric power generation, industry, commercial, waste heat utilization, energy conservation, education, demonstration activities) under which listings are arranged alphabetically by performing organiza-

ton. Information on contact person, sponsor, funding amount, date, summary, and publications are also included.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 5438, 5770, 5862, 5891

5823 (INIS-mf—4762) **Eliminating nuclear power.** Nyten, T.; Johansson, R. (eds.). (Statens Vattenfallsverk, Stockholm (Sweden)). Oct 1977. 93p. (In Swedish). Dep. NTIS (US Sales Only), PC A06/MF A01.

A study, initiated by the Swedish Energy Commission, of the possibilities to discontinue the use of nuclear power by year 1985. The report deals with economical, technical and environmental consequences of converting nuclear power stations to coal firing. Comparisons of activity realses from nuclear and coal fired power stations are reported. A review of foreign studies of decommissioning is presented.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 5329, 5799, 5945, 5946

5824 (ANL/CES/TE—79-7) **Fuel distribution.** Tison, R.R.; Baker, N.R.; Blazek, C.F. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 79p. Dep. NTIS, PC A05/MF A01.

Distribution of fuel is considered from a supply point to the secondary conversion sites and ultimate end users. All distribution is intracity with the maximum distance between the supply point and end-use site generally considered to be 15 mi. The fuels discussed are: coal or coal-like solids, methanol, No. 2 fuel oil, No. 6 fuel oil, high-Btu gas, medium-Btu gas, and low-Btu gas. Although the fuel state, i.e., gas, liquid, etc., can have a major impact on the distribution system, the source of these fuels (e.g., naturally-occurring or coal-derived) does not. Single-source, single-termination point and single-source, multi-termination point systems for liquid, gaseous, and solid fuel distribution are considered. Transport modes and the fuels associated with each mode are: by truck - coal, methanol, No. 2 fuel oil, and No. 6 fuel oil; and by pipeline - coal, methane, No. 2 fuel oil, No. 6 oil, high-Btu gas, medium-Btu gas, and low-Btu gas. Data provided for each distribution system include component makeup and initial costs.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 5904, 5928, 5934, 5936, 5937, 5939

5825 (INKA-Conf—78-314-000(Pt.1)) **Possibilities of industrial power-heat generation (PHC 0 to 5 MW).** (Gesellschaft fuer Tagungen und Kongresse m.b.H., Graefelfing (Germany, F.R.)). 1978. 236p. (In German). (CONF-7810219—(Pt.1)). Dep. NTIS (US Sales Only), PC A11/MF A01.

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

A separate abstract was prepared for each paper presented at the conference. (RCK)

5826 (INKA-Conf—78-314-000(Pt.1), pp 10p, Paper 1) **District heat supply and power-heat coupling in the promotion programme of the German Ministry of Research and Technology (BMFT).** Stahl, E. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

Starting from the present and future energy situation, some research and development aspects of the BMFT promotion program are outlined with regard to district heat supply and power-heat cogeneration.

5827 (INKA-Conf—78-314-000(Pt.1), pp 20p, Paper 2) **Power-heat coupling in Baden-Wuerttemberg energy policy.** Grawe, J. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

After a brief explanation of the possible energy saving by power-heat co-generation, the present situation, as well as the future facilities of power-heat co-generation in Baden-Wuerttemberg, are discussed. Moreover, all measures taken by the government in favor of the power-heat co-generation are specified.

5828 (INKA-Conf—78-314-000(Pt.1), pp 15p, Paper 3) **Problem of supplying independent industrial power generation plants with additional power or power reserves under the aspect of cartel law.** Klaue. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The paper reports on some actions anchored in cartel law which might be taken in order to introduce a sensible relationship between independent power generation industry and public utilities on the one hand and, on the other hand, official energy policy. The author tries to illustrate which party may apply the respective standards concerning the three complexes of additional power procurement, procurement with power reserves or circuit, and which directions have been worked out for the application of these standards up to now.

5829 (INKA-Conf—78-314-000(Pt.1), pp 13p, Paper 4) **Independent power generation in industrial plants from the view of public utilities.** Bierhoff, R. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

Public power utilities are not afraid of competing with private power industry. They are prepared for the future to accept electrical energy from industrial power-heat co-generation at adequate prices. However, they struggle against distortions in competition being effected in favor of independent power-generating industries and becoming a burden for all customers provided with electricity. It cannot be the aim of energy policy to promote the production of electricity and heat without saving a considerable amount of energy. Only the original power-energy co-generation method in pure counterpressure operation makes the disadvantage of changing the fuel basis seem justifiable. Some reasons are given why there is no physical existence of an electrical energy flow within a network and why it cannot be forced.

5830 (INKA-Conf—78-314-000(Pt.1), pp 17p, Paper 5) **Assessment of independent power generation in industrial plants seen from an industrial view under the aspect of energy policy.** Spilling, H. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The state of negotiations between industry and the public power utilities is reported concerning a more effective electricity supply with regard to economy by improving cooperation. This implies an expansion of independent power generation with the help of power-heat supply in favor of using fossil primary energy for energy supply which will be curbed in the future. The significance of power-heat supply within the range 0 to 5 MW under the aspect of energy policy is discussed.

5831 (INKA-Conf—78-314-000(Pt.1), pp 11p, Paper 6) **District heat for industry: supply facility - pricing sovereignty.** Ernst, H. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The possibility is discussed of an efficient technical and economical symbiosis between public utilities and industry in the field of district heat supply provided that industry is not impeded by embargoes from the side of public utilities.

5832 (INKA-Conf—78-314-000(Pt.1), pp 12p, Paper 7) **Energetic operation analysis as a basis for power-heat coupling from the view of the energy consultant.** Hoppe, H.; Wiedemann, L.; Brand, B. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The paper illustrates the position, the tasks, and the practice of energy consultants.

5833 (INKA-Conf—78-314-000(Pt.1), pp 24p, Paper 8) **Energetic operation analysis as a basis for power-heat coupling from the view of the designer.** Bissinger, B. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The general criteria for the design or expansion of power-heat co-generation in industrial plants can be applied according to energy demand and the energy supply situation. The paper refers to power-heat co-generation with the steam process as well as with the diesel or the gas turbine process.

5834 (INKA-Conf—78-314-000(Pt.1), pp 7p, Paper 9) **District heat for industry: security of supply - sovereignty of supply.** Dommann, D. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

It is shown from the view of public utilities that the demands of industry for security as to power supply must not necessarily lead to a sovereignity of the public utilities in questions of supply. Mutual interests are coordinated by negotiating on a basis of partnership. In this context the required coverage of the high investment risk for generating and distributing plants are particularly emphasized.

5835 (INKA-Conf—78-314-000(Pt.1), pp 31p, Paper 10) **Steam generators under the aspect of power-heat coupling.** Voss, W. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

After a comment on the significance of power-heat co-generation and after listing all criteria for its application the standards for steam vessels in industrial plants, vessel construction modes for power-heat co-generation are discussed. Vessels in a textile factory, coal vessels in a cotton combing factory, and bark vessels in a sugar factory are described as special examples.

5836 (INKA-Conf—78-314-000(Pt.1), pp 25p, Paper 11) **Heat-power coupling with steam turbines and steam vessels.** Gerstbrein, R. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The following topics are discussed: (a) the significance of the steam process during industrial power-heat co-generation; (b) the energy demand range for electrical energy and heat which is of interest for power-heat co-generation; and (c) manufacturing or processing processes for which power-heat co-generation is of interest.

5837 (INKA-Conf—78-314-000(Pt.1), pp 8p, Paper 12) **Energetic operation analysis.** Maier, K.H. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The advantages and the efficiency of power-heat co-generation application in industry is discussed. The energetic operation analysis relates to the estimation of heat demand, heat generation, the demand for mechanical or electrical energy, and independent power generation as well as outside power supply.

5838 (INKA-Conf—78-314-000(Pt.1), pp 18p, Paper 13) **Power-heat coupling with steam turbines serving as a direct motive power.** Heigenhauser, B. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

With special regard for pollution protection laws, an industrial plant which generates both heat and electric power was built for the impregnation of railroad ties with tar oil.

5839 (INKA-Conf—78-314-000(Pt.1), pp 19p, Paper 14) **Power-heat coupling: a typical example from wood industry.** Maiwert, H. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

With the help of operating data from a wood processing factory it is pointed out how the profitability of a plant is influenced by the application of power-heat co-generation.

5840 (INKA-Conf—78-314-000(Pt.2)) **Possibilities of industrial power-heat generation (PHC 0 to 5 MW).** (Gesellschaft fuer Tagungen und Kongresse m.b.H., Graefelfing (Germany, F.R.)). 1978. 217p. (In German). (CONF-7810219—(Pt.2)). Dep. NTIS (US Sales Only), PC A10/MF A01.

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

A separate abstract was prepared for each paper presented at the conference. (RCK)

5841 (INKA-Conf—78-314-000(Pt.2), pp 14p, Paper 1) **Power-heat coupling plant of the Hacker-Pschorr Braeu AG, Munich.** Treiber, K. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The power-heat co-generation plan of a large-scale brewery is specified. The specific heat consumption, the cost of in-house power generation, and cost savings gained are determined. In-house power costs and extraneous power costs are contrasted.

5842 (INKA-Conf—78-314-000(Pt.2), pp 16p, Paper 2) **Power-heat coupling with a steam turbine serving as a direct propellant.** Diehl, K. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The difference between the classical co-generation and co-generation with a steam turbine serving as a direct propellant is outlined. Application criteria are specified and the investment costs are illustrated with the help of three concrete examples.

5843 (INKA-Conf—78-314-000(Pt.2), pp 14p, Paper 3) **Energy saving by PHC with a steam turbine serving as a direct propellant.** Karsten, W. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The lecture reports on some variants of power-heat co-generation during the production of salt from brine and deals in particular with the variant which is in operation at the salt-pit of Reichenhall.

5844 (INKA-Conf—78-314-000(Pt.2), pp 33p, Paper 4) **Power-heat coupling with gas turbines.** Aguet, E. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The classical design of power-heat co-generation with gas turbines, the economics of power generation, the regulating facilities, the cost of energy generation, the application fields, as well as the construction and disposition of the plants are dealt with.

5845 (INKA-Conf—78-314-000(Pt.2), pp 6p, Paper 5) **Operation experiences with gas turbines.** Huber, P. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

A vivid description of the operation experiences resulting from the application of gas turbines in a power-heat plant of a brickyard is presented.

5846 (INKA-Conf—78-314-000(Pt.2), pp 30p, Paper 6) **Unitized construction machines used as auxiliary engines and compressors for the working media vapour, natural gas and other gases.** Luetge, R. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The steam engine with a performance range from 500 to 2000 kW can be regarded as the ideal power engine for industrial power-heat co-generation because it shows a promising partial load behavior. The steam engine developed by the Spilling factory according to the unitized construction principle, can, by simply exchanging cylinders, be used either as an expansion engine controlled by power-heat co-generation or as heat pump compressor.

5847 (INKA-Conf—78-314-000(Pt.2), pp 19p, Paper 7) **Circuiting possibilities and expansion steps of PHC with steam engines.** Huth, E. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

Using the example of a brewery, the economic advantage of combined heat and power generation is outlined, and it is shown why a steam engine was preferred over a turbine.

5848 (INKA-Conf—78-314-000(Pt.2), pp 23p, Paper 8) **Possibilities of industrial combined heat and power generation using diesel and gas engines.** Detzer, K.; Dischinger, E.; Titl, A. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

After a short historical survey, present possibilities of combined heat and power generation using diesel and gas engines are pointed out, and standardized modules for combined heat and power generation are presented. Other subjects discussed are the design of the plants, their control technology, and maintenance. A few remarks on economics are also presented.

5849 (INKA-Conf—78-314-000(Pt.2), pp 12p, Paper 9) **Combined heat and power generation with stationary internal combustion engines and heat pumps.** Zacharias, F. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

The criteria of use of dual-purpose systems with stationary internal combustion engines and heat pumps from the point of view of national economy, technology, ecology, and economics are discussed. Future prospects are outlined.

5850 (INKA-Conf—78-314-000(Pt.2), pp 13p, Paper 10) **Heat pumps with internal combustion engines: planning and operation.** Paul, J. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

Heat pumps driven by internal combustion engines are complex in design and difficult to control. Monovalent operation of a heat pump with gas or diesel engine is possible, but separate machinery sets should be used which can be connected or disconnected during part load operation. In case of cyclic operation, a storage unit is absolutely necessary in order to avoid too frequent starting and stopping of the engine. The temperature spread of the heat consumers should be as high as possible in order to keep the condensation temperature low.

5851 (INKA-Conf—78-314-000(Pt.2), pp 10p, Paper 11) **Control of combined heat and power generation.** Kuehnlein, H. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

On the basis of flowsheets, 11 circuiting examples are given for the control of combined heat and power generation.

5852 (INKA-Conf—78-314-000(Pt.2), pp 23p, Paper 12) **Combined heat and power generation: when it is economical.** Maier, K.H. 1978. (In German).

From Energy congress on possibilities of industrial combined heat and power generation; Muenchen, F.R. Germany (25 Oct 1978).

For determining the economics of a co-generation plant, an energy analysis was made of the undertaking as required, as well as an investigation of techniques offered as well as assessment of the economic consequences of the variants chosen. The paper describes these steps and gives hints concerning the resulting calculations.

5853 (ORNL/TM—6830-P2) **District heating/cogeneration application studies for the Minneapolis-St. Paul area. Overall feasibility and economic viability for a district heating/new cogeneration system in Minneapolis-St. Paul.** Margen, P.; Larsson, K.; Cronholm, L.A.; Marklund, J.E. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 147p. Dep. NTIS, PC A07/MF A01.

A study was undertaken to determine the feasibility of introducing a large-scale, hot water, district heating system for the Minneapolis-St. Paul area. The analysis was based on modern-European hot-water district heating concepts in which cogeneration power plants supply the base-load thermal energy. Heat would be supplied from converted turbines of existing coal-fired plants in Minneapolis and St. Paul. Toward the end of the 20-year development period, one or two new cogeneration units would be required. Thus, the district heating system could use low-grade heat from either coal-fired or nuclear cogeneration power stations to replace the space heating fuels currently used - natural gas and distillate oil. It is concluded that the concept is technically feasible, it has great value for fuel conservation, and with appropriate financing the system is economically viable.

5854 (LIB-tr—4763) **Energy conversation - a concept. We must all make sure that it becomes a reality.** Translated from *Centra-Burkle Inf. Bull.;* No. 2, 1-2(1978). 9p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Recently passed legislation in the Federal Republic of Germany pertaining to energy conservation in new and older buildings and to thermal insulation, space conditioning systems, and water heaters used in buildings is discussed. (LCL)

CONSERVATION

REFER ALSO TO CITATION(S) 5898, 5911, 5912, 5913, 5915, 5916, 5920, 5921, 5936

5855 (DOE/IR—0055) **Consumer protection issues in energy: a guide for attorneys general. Insulation, solar, automobile device, home devices.** (Department of Energy, Washington, DC (USA). Office of Consumer Affairs). Nov 1979. 151p. Dep. NTIS, PC A08/MF A01.

The guide attempts to bring together two important and current issues: energy and consumer protection. Perhaps the most basic consumer-protection issue in the energy area is assuring adequate supplies at adequate prices. It is anticipated, though, that consumers will want to consider new ways to lower enegy consumption and cost, and will thus be susceptible to fraudulent energy claims. Information is prepared on insulation, solar, energy-saving devices for the home, and energy-saving devices for the automobile.

5856 Warren-Alquist State Energy Resources Conservation and Development Act, Public Resources Code Section 25000 et seq. Incorporated are all amendments to the Act through 1978. Sacramento, CA; California Energy Commission (1978). 97p. (NP—24044). California Energy Commission, 1111 Howe Ave., Sacramento, CA.

The text of the Warren-Alquist State Energy Resources Conservation and Development Act is given. The chapters of the Act are: Title and General Provisions; Definitions; State Energy Resources Conservation and Development Commission; Planning and Forecasting; Energy Resources Conservation; Power Facility and Site Certification; Research and Development; Energy Shortage Contingency Planning; State Energy Resources Conservation and Development Accounts; Enforcement and Judicial Review. The Articles are also included. (MCW)

5857 Energy conservation. Hearings before the Subcommittee on Energy of the Joint Economic Committee, Congress of the United States, Ninety-Fourth Congress, Second Session, February 2, 3, and 24, and April 13, 1976. Washington, DC; Joint Economic Committee (1977). 296p. GPO.

The hearings were held to discuss the idea that a national commitment to energy conservation is a necessary next step in forming an effective and workable energy policy. A lack of public enthusiasm for conservation is attributed partly to the public's linking of conservation with curtailments and shortages during the 1973 oil embargo. Rising fuel costs and depleting resources make efficiency and conservation economically valid goals. Witnesses testified on ways to reduce energy consumption in the short-, mid-, and long-term, the cost effectiveness of conservation opportunities, how to engage the general public in the effort, and how to define the proper role of the Federal government. Witnesses included members of Congress and state governments, representatives of ERDA and other agencies, private business, and private citizens. Frank Zarb of the Federal Energy Administration pointed to the new Energy Policy and Conservation Act as an important step, but emphasized the need to make the public aware that energy-efficiency efforts will create jobs and a higher standard of living and will save dollars as well as the environment. (DCK)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 5343, 5804, 5808, 5809, 5817, 5860, 5897, 5914

5858 (EPRI-EA—1119) **Integrated forecasting model.** Barrager, S.; Balson, W. (Decision Focus, Inc., Palo Alto, CA (USA)). Aug 1979. 63p. Dep. NTIS, PC A04/MF A01.

A supply-demand equilibrium model has been developed to provide integrated forecasts of energy prices and quantities. The Integrated Forecasting Model (IFM) provides an integrating framework for information from supply and demand models; generates integrated price and quantity forecasts for research and development (R and D) planning; and provides a tool for special R and D analysis. The IFM uses submodels developed for the Demand 77 (EPRI-EA-621-SR) and the Supply 77 (EPRI-EA-634-SR) forecasts and expert judgment where models do not exist. This report briefly describes the methodology used to integrate the submodels and presents preliminary base case results.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 5342, 5516, 5808, 5818, 5828, 5856, 5857, 5865, 5871, 5875, 5919

5859 (DOE/IR—0008(Rev.)) **Activities of the Department of Energy in energy education. A description of programs for schools of the Department of Energy and its predecessor agencies.** (Department of Energy, Washington, DC (USA). Office of Education, Business and Labor Affairs). Nov 1979. 72p. Dep. NTIS, PC A04/MF A01.

The various programs of the DOE, ERDA, FEA, and AEC for energy education in schools are described. Areas of special emphasis are training, curriculum development, educational special events, facilities support, and the Energy Extension Service. 1 figure, 13 tables. (RWR)

5860 (DOE/TIC—10288) **New England Energy Congress: a blueprint for energy action.** (New England Energy Congress, Somerville, MA (USA)). May 1979. 506p. Dep. NTIS, PC A22/MF A01.

The severity of New England's energy problem is first noted. The Energy Congress was launched to provide aid in reducing the region's dependence on foreign oil and its cost disadvantages compared to the rest of the country. The work of the Congress is summarized. Recommendations addressing the demand side of the energy equation are presented and then an analysis and recommendations addressing supply options follow. Extensive information from the New England Energy Supply Committee; Joint Committee on Alternatives; Economic Development Through Alternate Sources of Energy Committee; New England Energy Demand Committee; Conservation/Demand Transportation Committee Report; Energy Conservation Committee; Residential Energy Package; Regulatory and Institutional Processes Committee; and Energy Economics and Financing Committee is given.

5861 (SAND—78-1333) **Brief survey of energy-related legislation considered in the 1978 session of the 33rd New Mexico Legislature.** Barsumian, L.; Vandevender, S.G. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 40p. Dep. NTIS, PC A03/MF A01.

This paper surveys the energy legislation considered in the 1978 legislative session and the continuing evolution of the New Mexico Legislative policy toward state energy issues. By law, this session of the 33rd Legislature was to have been devoted primarily to fiscal matters. Its level of attention to energy issues necessitating policy decisions reflects this. A few energy issues were considered, mainly those having been carried over from the 1977 session.

5862 (SAND—79-1095) **1979 New Mexico legislative session: energy issues and legislation.** Barsumian, L.; Vandevender, S.G. (New Mexico Univ., Albuquerque (USA); Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 121p. Dep. NTIS, PC A06/MF A01.

This report is an account of the energy legislation and associated issues considered during the 1979 session of the 34th New

Mexico Legislature. The session's major issue was the federal study of a proposed nuclear Waste Isolation Pilot Plant (WIPP) in New Mexico. A large proportion of time and effort was spent on resolving the state's formal position toward the federal project. However, other energy concerns were also significant even though they were neither as controversial nor as visible as the primary issue. The two most important laws enacted were the Radioactive Waste Consultation Act and the Radioactive Waste Transportation Act. The Legislature considered 47 other energy-related bills, of which 17 were enacted.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 5801, 5950

COAL

REFER ALSO TO CITATION(S) 5329, 5342, 5343, 5691, 5865, 5867, 5891

PETROLEUM

REFER ALSO TO CITATION(S) 5329, 5342, 5347, 5369, 5891, 5897

NATURAL GAS

REFER ALSO TO CITATION(S) 5329, 5347, 5376, 5377, 5891, 5897

ELECTRIC POWER

REFER ALSO TO CITATION(S) 5897

5863 (EPRI-EA—1152) **Evaluation of the Federal Energy Administration's load-management and rate-design demonstration projects. Final report.** Hill, D.H.; Groves, R.M.; Howrey, E.P.; Kline, A.C.; Kohler, D.F.; Lepkowski, J.M.; Smith, M.A. (Michigan Univ., Ann Arbor (USA). Inst. for Social Research). Aug 1979. 298p. Dep. NTIS, PC A13/MF A01.

Declining load factors and increases in the price of fossil fuels for peaking capacity have combined to make load management important to the electric utility industry. In response, the Federal government, utilities, and state utility commissions have conducted a number of load management and rate design demonstration projects to test the practicality of time-of-use and other innovative rate structures. This report evaluates the usefulness of the data from these projects for model building and other analysis. Particular attention is paid to the sampling methodologies employed. In general, this study has found that the demonstration projects were performed in such a manner as to make extrapolation of results beyond the experimental populations statistically tenuous. The major causes of this limitation are the widespread practice of excluding entire classes of residential customers and the decision not to employ probability sampling at the national level. Some experiments are less seriously affected by the former problem. The study finds that if extensive preliminary analysis is conducted, data from these experiments may be used for the estimation of econometric models.

5864 (EPRI-EL—1198(Vol.2)) **Research into load forecasting and distribution planning. Final report.** Northcote-Green, J.E.D.; Cummings, A.B.; Wilreker, V.F. (Westinghouse Electric Corp., East Pittsburgh, PA (USA)). Oct 1979. 320p. Dep. NTIS, PC A14/MF A01.

This project describes work completed in fulfillment of Phase I of EPRI Research Project 570-1, Research into load forecasting and distribution planning. Two small area-load-forecasting methods were selected from five candidates. Each method is written into a production computer program for utility use. The simplest program, TREND, uses advanced time-series trend-analysis methods with many curve-form options. The program requires six years of historical electrical-demand data by small area. The second program, MULTIVARIATE, requires both control and demand data by small area. A clustering procedure is used to linearize the process before the MULTIVARIATE parameter estimation. In addition to two years of historical data, MULTIVARIATE requires estimates of future control data. Four methods of obtaining control data are identified. LANDSAT is examined as a source of historical land-use data. An urban model EMPIRIC is applied to the test utility to give estimates of future control variables. Both land-forecasting programs are applied in a utility environment on the test utilities of the Salt River Project and Pacific Gas and Electric. Accuracy and comparison tests of the two programs are included.

5865 (NUS—3095) **Impact of implementation of new regulations on power station construction schedules and costs.** (NUS Corp., Rockville, MD (USA)). Jan 1978. 58p. NUS Corporation, Rockville, MD.

The determination of the point at which construction is commenced on a major emitting facility is of central importance under EPA's revised and proposed Prevention of Significant Deterioration (PSD) regulations. For example, the commencement of construction date will control whether or not new PSD requirements will apply to a particular facility. Also, unless a major emitting facility has commenced construction within 18 months of the issuance of its PSD permit, it risks losing its permit. The amended Clean Air Act states: the term commenced as applied to construction of a major emitting facility means that the owner or operator has obtained all necessary preconstruction approvals or permits required by Federal, state, or local air-pollution emissions or air-quality laws or regulations and either has (i) begun, or caused to begin, a continuous program of physical on-site construction of the facility, or (ii) entered into binding agreements or contractual obligations, which cannot be canceled or modified without substantial loss to the owner or operator, to undertake a program of construction of the facility to be completed within a reasonable time. This report focuses on the latter part of this definition which recognizes that construction of a facility may commence prior to work on-site through commitments to a program of construction for the facility. The report describes in general terms utility construction programs for new coal-fired plants, and identifies factors that should be considered in applying the substantial loss criterion to particular cases involving such construction programs.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 5891

5866 (DOE/EIA—6366/1) **Power plant dispatch study: an analysis of the PIES model of electric utility dispatch.** Sustman, J.E. (Energy Management Associates, Inc., Atlanta, GA (USA)). 5 Nov 1979. Contract EI-78-C-01-6366. 33p. Dep. NTIS, PC A03/MF A01.

The electric utility sector sub-model within PIES uses a number of modeling approximations in order to formulate the power plant dispatch in a linear programming framework. Several such modeling details were studied using a probabilistic dispatch model (PROMOD III) to quantify the error introduced by each. These tests indicate that PIES tends to significantly underpredict the consumption of high cost fuels (distillates, etc.) by the electric utility sector. Two adjustments to the PIES model are suggested as means of overcoming this problem.

5867 (LA—8033-MS) **Economic and environmental analysis of large and small electric power stations in the Rocky Mountain West.** Ford, A.; Flaim, T. (comps.). (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 206p. Dep. NTIS, PC A10/MF A01.

This report provides a detailed, technical account of the results of a 2-year study of small vs. large coal-fired power plants in the Rocky Mountain West. Prepared by an interdisciplinary team of scientists, the report examines the differences between a single 3000-MW plant and several 500-MW plants that would deliver an equivalent amount of electrical power. Economic issues examined in the study include the tradeoffs between economies of scale and reliability, the problems of obtaining permit approval, the accuracy of load forecasting, and the difficulties in planning and financing capacity additions. Environmental issues include the degradation of atmospheric visibility caused by air pollution, the effect of mining, transporting, and burning coal on occupational and public health and safety, the boom town impacts on the small towns near the construction sites, and the impacts associated with the consumption of water for plant cooling. The economic and environmental analyses were performed for large and small plants that are located in southeastern Utah, burn coal from nearby underground mines, and transmit electricity to southern California for consumption. The report concludes with a summary of the economic and environmental results of the comparison of large and small plants. Environmental differences are found to be extremely dependent on site specific features. Consequently, the environmental findings are not easily transferred to other regions of the country. The economic differences, on the other hand, are much less dependent on the specific set of assumptions used in the study and, therefore, are more likely to apply to utilities operating in other regions of the country.

5868 **Spatial equilibrium perspective for planning the production of electrical energy.** Uri, N.D. (Dept. of Energy, Washington, DC). *Environ. Manage.*; **2**: No. 5, 413-421(Sep 1978).

A spatial and temporal equilibrium model of production, consumption, prices, and transmission is of constructed to determine the efficient pricing and allocation of electrical energy in the United States. Regional coordination is technically feasible and economically attractive. It also maximizes environmental efficiencies. The duplication of electrical generation and transmission facilities yields a misallocation of resources. The utilities put forth specific arguments

against coordinated operations. Yet in a fully integrated power system, each region would be expected to maximize the benefits of time diversity by purchasing from outside the region in lieu of the expansion of regional capacity. The Federal Energy Regulatory Commission has not yet made a serious move to encourage regional coordination and planning, but the Commission has the authority to promote such operations if it chooses to do so.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 5868

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 5815, 5911, 5915, 5921

5869 (ORNL/TM—6977) **State flows of energy in 1975.** Rice, P.L. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 429p. Dep. NTIS, PC A19/MF A01.

This report highlights the distribution or flows of energy between states; it provides a supplement to Energy Availabilities for State and Local Development: 1975 Data Volume (ORNL/TM-6951). State flows are reported for the ten energy regions defined by the Department of Energy. Energy imports and exports are disaggregated into foreign and inter-regional components and the mode of transport indicated. The best analysis and presentation of energy flows is for natural gas. The report provides reference material on natural gas consumption, production, and distribution and has potential utility for: (1) determining the potential impact of curtailments; and (2) conducting cost-benefit analyses of the redistribution of natural gas between users and between states. Of equal significance is the integration and consolidation of data for crude oil and petroleum-product flows. Unpublished state-to-state flows by tanker and barge from PAD III (the largest petroleum-producing region) were combined with information on inter-regional pipeline shipments and foreign shipments to create a complete picture of the production, consumption, and distribution of all petroleum products, such as gasoline. There is additional information on flows of coal and electricity. The data for bituminous coal shipments between states is for utilities with 25 megawatts or greater capacity. The electricity data is based on the Form 412 reports filed by large utilities in 1974.

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 5801, 5806

SOLAR

REFER ALSO TO CITATION(S) 5492, 5516, 5518, 5543, 5548, 6171, 6172, 6184

5870 (TID—28830/1) **Domestic policy review of solar energy. Volume 1. Final report, international panel.** (Department of Energy, Washington, DC (USA)). Oct 1978. 58p. Dep. NTIS, PC A04/MF A01.

The Federal government has a growing number of international activities relating to solar energy. These programs, which are assuming increased importance within the overall context of US foreign policy in energy, derive from different legislative authorities (Section 2) and serve a variety of US interest. Overlapping jurisdictions appear to exist with regard to programs with developing countries. The scope of existing activities is broad, including cooperative arrangements and agreements with both industrial and developing countries in research and development on solar technologies, energy and resource assessments, training in energy management, institutional development and demonstration of solar technologies (Section 3). A brief assessment of major activities is provided in Section 4.

5871 (TID—28830/2) **Domestic policy review of solar energy. Volume 2. Final report, international panel.** (Department of Energy, Washington, DC (USA)). Oct 1978. 86p. Dep. NTIS, PC A05/MF A01.

To date, US solar technology, development, and commercialization have concentrated on domestic needs. The international arena does provide the US with an exceptional opportunity to advance several major foreign policy goals, namely: helping to ease the pressure on world fossil-fuel demand; cooperating with the industrialized countries in meeting the global energy challenge; helping the developing countries to attain greater energy and economic self-sufficiency; and improving the US trade and balance-of-payment. Discussed in detail are three interrelated initiatives, each of which is essential to a successful international effort. The first is commercialization of solar energy abroad by market identificaton and development, to create general world-wide demand and promote international trade, in which all interested countries can participate along with the US. The next is technical cooperation to bring about improvements in solar technologies, especially by developmental and demonstrational projects aimed at creating marketable, commercially viable systems and equipment. Cooperation with developing countries to bring about optimum energy resource development, with the help of appropriate international financial and technical assistance is the third option discussed. (MCW)

5872 (TID—28831) **Domestic Policy Review of Solar Energy. Financing and Incentives Panel final report.** (Department of Energy, Washington, DC (USA)). Oct 1978. 170p. Dep. NTIS, PC A08/MF A01.

This program review performed by the Financing and Incentives Panel includes the few Federal programs specifically concerned with financing of solar energy systems and many programs of Federal financial assistance which have other general purposes but could include investments in solar applications. The latter programs amount to many billion dollars in present authority of which part could be applied to solar investments. A significant impact on the utilization of solar-energy devices would result from this redirection of existing authority. The criteria used identifies current Federal financial programs and evaluates their potential to assist the financing of solar investments. The framework for evaluation is centered on the goal to discover alternatives for Federal financial action through existing programs which would accelerate the commercialization of solar technology and increase its contribution to national energy requirements by the year 2000.

5873 (TID—28832) **Domestic Policy Review of Solar Energy. Federal Operations Panel final report.** (Department of Energy, Washington, DC (USA)). Oct 1978. 248p. Dep. NTIS, PC A11/MF A01.

The initiation of the Domestic Policy Review of Solar Energy on Sun Day, May 3, 1978, resulted in the organizing of an interagency DPR consisting of six groups or panels. This report covers the activities of the Federal Operations Panel. Policy options approved by the panel and recommended to the integrating group are: Federal agencies as users of energy to operate buildings and facilities: new Federal buildings; existing Federal buildings; and Federal leased space; Solar Energy Council to implement Federal facilities program; determination of cost-effectiveness of proposed active solar systems; use of alternate fuels from biomass in Federal government operations; solar energy integration experiments and demonstrations by the Federal power generation and marketing agencies; and acceleration of solar energy use through the Federal power generation and marketing agencies. Copies of these policy options are included as Appendix F. Additional data on the panel organization, functions, and work plan are included in Appendices A through E. (MCW)

5874 (TID—28837) **Domestic Policy Review of Solar Energy. Research, Design and Development Panel final report.** (Department of Energy, Washington, DC (USA)). Oct 1978. 280p. Dep. NTIS, PC A13/MF A01.

The Solar Energy Policy Committee was directed to review the current Federal programs related to research, development, and demonstration and to develop policy options and recommendations to accelerate the use of solar energy, in both the short and long term. The Panel examined priorities and policies of the existing research programs to determine whether they can be improved. Each technology's current scientific status, economic competitiveness, and promise for engineering, scientific, and economic advances were reviewed in order to determine the potential for making a contribution to the nation's energy needs and how that potential might be realized by Federally supported research. The following solar research strategies are considered: heating and cooling; agricultural and industrial process heat; solar thermal; photovoltaics; wind energy; ocean thermal; biomass; small scale hydropower; support to lesser developed countries; and solar-powered satellite. (MCW)

5875 Economics of solar energy. Hearing before the Joint Economic Committee, Congress of the United States, Ninety-Fourth Congress, Second Session, April 5, 1976. Washington, DC; Joint Economic Committee (1977). 68p. GPO.

Hearings were held to advise the committee on the status of solar energy development and the economics of widespread utilization. Sen. Humphrey, Chairman, expressed concern that, with the exception of solar water heating, progress has been slower than desired. He placed part of the blame on the failure of government to actively promote research and development on a commercial scale. Witnesses included representatives of government and various research programs. Reports were made by the Jet Propulsion Laboratory, National Aeronautics and Space Administration, and others on their progress and estimates of future developments. Solar energy was discussed as a partial solution to our energy problems, and one that doesn't require scientific breakthroughs or vast exploration efforts. Confidence was expressed that costs will become competi-

tive. Requests were made for funding photovoltaic, solar thermal-electric, and energy-storage programs. Adequate funding of solar research will require taking some funds from nuclear and fossil-fuel programs and establishing a long-term commitment to pursue solar energy. A systems approach was recommended as the most cost-effective way of accomplishing commercialization, with the government underwriting the cost of research and demonstration. The identification of early markets and applications will enable commercialization to proceed. Studies are now underway to combine fossil-fuel and solar power plants. (DCK)

OTHER

REFER ALSO TO CITATION(S) 5486, 5668

ENERGY CONVERSION

MHD GENERATORS

DESIGN AND DEVELOPMENT

5876 (FE—2341-11) **High magnetic field MHD generator program. Quarterly report, October-December 1978.** Eustis, R.H.; Kruger, C.H.; Mitchner, M. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Jan 1979. Contract EX-76-C-01-2341. 33p. Dep. NTIS, PC A03/MF A01.

The objective of this program is to investigate the high magnetic field effects in MHD channels which will influence the design of large scale generators. The work includes the study of high fields of (1) plasma nonuniformities and instabilities and (2) boundary layer and Hall field phenomena. In addition a third activity is centered on the existing Stanford 6 tesla magnet where small scale linear and disk channels are investigated. The modifications to the High Temperature Gasdynamics Laboratory were completed so that space is available for the 7 tesla superconducting magnet to be furnished by the Department of Energy. The continued analysis of the fluctuations in the MHD channel showed standing acoustic waves and the presence of non-uniformities convected with the flow. Further development of the laser fluorescence technique to measure temperature and seed concentration with 3-dimensional spatial resolution for time varying flows was undertaken with good success. Preparations continued for three experiments to be run next quarter - an electrode boundary layer experiment to investigate Joule heating effects, a thermal check-out of the 6 tesla disk generator system and a thermal check-out of the 6 tesla linear channel. (WHK)

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 5876

5877 (CONF-790640—6) **Kinetics of char burnout and ash vaporization in coal-fired MHD combustors.** Shuck, R.; Hastings, T.; Mims, C.; Sarofim, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1979. Contract EX-76-C-01-2215. 9p. Dep. NTIS, PC A02/MF A01.

From 18. symposium on engineering aspects of magnetohydrodynamics; Butte, MT, USA (18 Jun 1979).

A computer model which simulates coal combustion in a simple MHD combustor was assembled. Data from parallel experimental work on devolatilization, char oxidation, and ash vaporization at MHD conditions provide input parameters to the model and provide checks on some of the assumptions therein. Trade-offs between ash vaporization and char utilization predicted by the model are shown. The importance of CO_2, H_2O, O_2, O, and OH to char oxidation is indicated from both theoretical and experimental considerations.

5878 (CONF-791014—, pp IV.54-IV.55) **Materials research for the clean utilization of coal. Task 5: creep of MHD refractories.** Tighe, N.J.; Wiederhorn, S.M.; McDaniel, C. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5879 (CONF-791014—, pp V.47-V.48) **Materials research for the clean utilization of coal. Task 7: corrosion of downstream MHD components.** Schneider, S.J.; Smit, J. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5880 (CONF-791014—, pp V.77-V.79) **Testing and evaluation of MHD materials and substructures.** Murphree, D.L. (Mississippi State Univ.,State College). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5881 (CONF-791014—, pp V.80-V.83) **Materials evaluation and management of university MERDI supporting science and technology.** O'Hair, E.; Rasmussen, J.; Youngblood, G. (Montana Energy and MHD Research and Development Inst., Butte). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5882 (CONF-791014—, pp VI.10-VI.14) **Development and evaluation of materials for MHD power generation.** Bates, J.L. (Battelle Pacific Northwest Lab., Richland, WA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5883 (CONF-791014—, pp VI.15-VI.17) **Development, testing and evaluation of MHD materials and component designs.** Rossing, B.R. (Westinghouse Electric Corp., Pittsburgh, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5884 (CONF-791014—, pp VI.24-VI.26) **MHD air heater development materials technology.** Smyth, R.R. (FluiDyne Engineering Corp., Minneapolis, MN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5885 (CONF-791014—, pp VI.28-VI.32) **Materials research for the clean utilization of coal. Task 6: electrical transport mechanism in slag-electrochemical degradation of insulator and electrode materials.** Hosler, W.R.; White, G.; Negas, T. (National Bureau of Standards, Washington, DC). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5886 (CONF-791014—, pp VI.40-VI.42) **Improvements on $LaCrO_3$ based MHD electrodes.** Anderson, H.U. (Univ. of Missouri, Rolla). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5887 (FE—6010-13) **Development, testing, and evaluation of MHD-materials. Quarterly report for July-September 1978.** Hosler, W.R.; Negas, T.; Schneider, S.J. (National Bureau of Standards, Washington, DC (USA). Center for Materials Science). 30 Sep 1978. Contract EA-77-A-01-6010-035. 74p. Dep. NTIS, PC A04/MF A01.

A study was completed showing consistent increases in viscosity of several slags due to seeding with K_2O. The maximum increase was observed at 15 to 20 wt % K_2O. At 30% the viscosity was only slightly higher than unseeded slags. The electrical conductivity of a number of potential MHD electrode material has been measured. Interdiffusion of iron between MgO insulator material and MAFF-31 ($3MgAl_2O_4$:Fe_3O_4) was measured at 1400°C. The results indicate a strong temperature dependence, since diffusion coefficients at 1400°C were smaller by a factor 4 to 7 than those measured previously at 1600°C. Initial measurements on charge transport in slag indicate that the ionic conductivity in an Eastern coal slag is much less than the electronic conductivity at temperatures not much higher than the softening point of the slag. The phase compositions of six component Eastern and Western synthetic coal slags has been measured and analyzed. Approximately 50 materials have been analyzed structurally by x-ray diffraction methods including some of those tested in the U-02 Phase III experiment. A brief analysis of the electrodes from the recent 250 hour AVCO test is presented. Several samples from a unique deposit on the E wall - B wall joint in the USSR-U-25 RM channel have been analyzed and found to contain unaltered Al_2O_3 and $AlPO_4$ on the plasma side with some β-alumina at the center and near the wall side. Electrical conductivity measurements on a flowing layer of material joining the electrode and insulator wall of the Phase III U-02 experiment have been made. The procedures for laboratory testing of the hot corrosion of boiler tube and other steam plant components have been established. Initial tests on several materials are in progress. Results are presented and discussed. (WHK)

THERMOELECTRIC GENERATORS

REFER ALSO TO CITATION(S) 5529

FUEL CELLS

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 5234, 5890

MATERIALS, COMPONENTS, AND AUXILIARIES

5888 (AD-A—064554) **Fundamental solid electrode studies related to corrosion prevention, fuel cells and batteries. Final report, 1 Aug 1973-15 May 1978.** Bruckenstein, S. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). May 1978. 17p. NTIS, PC AA02/MF A01.

The study of surface phenomena at solid electrodes related to electrochemical power sources and corrosion processes was the major goal of this research. In particular, three kinds of surface processes were investigated: (1) Underpotential metal deposition, (2) neutral species adsorption and (3) insoluble film formation. New electroanalytical and electrochemical techniques were developed specifically for the purpose of studying such surface processes. These techniques made it possible to prepare solutions with extremely low levels of poisoning substances, to distinguish between surface and mass transport controlled processes, and to perform quantitative studies at the micromolar levels of electroactive species that arose in our studies. Underpotential deposition, UPD, of thallium, mercury and silver on gold have resulted in the determination of accurate adsorption isotherms and highly precise determination of the electrosorption valency. Electrosorption valency values for silver show a minimum near a surface coverage of 0.5. No minimum has ever been discovered before. It is believed that this minimum is caused by either a superlattice phenomena and/or a change in double layer structure. Mercury UPD studies established the existence of a spontaneous coulostatic process that can produce UPD for open circuited metal electrodes. Carbon monoxide, selected as a model neutral species adsorbate, was shown to exist in a number of adsorbed states on platinum.

5889 (CONF-791014—, pp V.69-V.74) **Evaluation of alloys for fuel cell heat exchangers.** Perkins, R.A. (Lockheed Palo Alto Research Labs., CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5890 (EPRI-EM—1114) **Development of sulfur-tolerant components for second-generation molten carbonate fuel cells.** Claar, T.D.; Marianowski, L.G.; Sammells, A.F. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1979. 139p. Dep. NTIS, PC A07/MF A01.

Future large-scale fuel cell power plant applications will require the use of hydrocarbon feeds such as coal, heavy oils, and distillates containing sulfur. As a result, depending on the fuel conversion and cleanup processes used, varying amounts of sulfur will appear in the fuel cell feed. Because both the cost and complexity of the total plant increase as the removal levels increase, it is essential to identify the gas purity requirements of molten carbonate fuel cells. Therefore, the objectives of this study are: (1) to establish the performance and endurance characteristics of molten carbonate fuel cells as a function of sulfur contaminants in both fuel and oxidant feed gases; (2) to identify the sulfur tolerance of cell materials; and (3) to establish cell performance as a function of gas composition at 5 and 10-atm pressure. Cell tests using a variety of sulfur concentrations indicated that the sulfur tolerance of present molten carbonate fuel cells is below 10 ppM in the incoming feed gases. Both cell performance losses and endurance limitations were observed at these levels and they were shown to occur primarily on the anode side of the cell. The performance losses are due to a combination of structural changes in the anode and reduced mass transfer characteristics of the carbonate melt caused by interactions between the carbonate melt and the sulfur species. The endurance limitations are due to corrosion of the current collector and other metallic components that were shown to be more severely corroded in the presence of the sulfur-containing gases. Potentially more sulfur-tolerant materials were identified in supplementary screening tests. (WHK)

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 5857

5891 (NP—24115) **Illinois energy consumption: 1963-1977.** Hill, L.; Biermann, W. (Illinois Inst. of Natural Resources, Springfield (USA); Illinois Dept. of Business and Economic Development, Springfield (USA)). Jun 1979. 39p. NTIS.

This report contains current and historical Illinois energy consumption data by consuming sector and fuel type. It also contains detailed descriptions of mapping techniques used in developing the data.

BUILDINGS

REFER ALSO TO CITATION(S) 5562, 5797, 5854, 5855

5892 (AD-A—064771) **Dead band controls guide. Final report.** Paoluccio, J.P. (Paoluccio (Joseph), La Jolla, CA (USA)). Nov 1978. Contract N68305-78-C-0011. 72p. NTIS, PC AA04/MF A01.

The purpose of this guide is to show methods of reducing energy consumption in new and existing heating, ventilating and air conditioning (HVAC) systems by using the Dead Band control strategy. Dead Band control strategy and its application to HVAC systems is discussed for three representative climatic zones in the continental United States. Computer modeling techniques provide predictions on energy savings due to control system modifications for six types of HVAC systems and two types of building construction, thermally heavy and thermally light. The operation of six HVAC systems is described and illustrated for existing and Dead Band control strategy. Computer simulation of these various systems demonstrates that substantial energy savings can be achieved by employing Dead Band control strategy. Bar graphs are provided illustrating relative energy used for each HVAC system. Engineering guidelines for the design of Dead Band control systems are presented in form of control schematics and logic diagrams for each HVAC system. Economic guidelines include techniques for estimating construction and maintenance cost, and performing economic analysis for each system. (Author)

5893 (LBL—9162) **Low pressure leakage function of a building.** Sherman, M.H.; Grimsrud, D.T.; Sonderegger, R.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 53p. (EEB-ENV—79-10). Dep. NTIS, PC A04/MF A01.

Many models have been devised to correlate air infiltration in buildings with weather parameters. A particularly promising strategy is to predict the air flow through the building envelope from surface pressures, which in turn are predicted from measured weather parameters. Due to interference of the weather, it is difficult to measure the pressure-flow relationship in a manner that is valid for the low surface pressures which have been observed to drive infiltration. Conventional techniques rely on steady-state (DC) fan pressurization or depressurization of the structure. DC-measurements are unreliable at pressures less than 5 to 10 Pa, but this is the pressure range that often drives natural infiltration. Thus, it is of interest to make direct measurements of air leakage vs. pressure in this low pressure region. Measurements of the leakage function measured at low pressures using an alternating (AC) pressure source with variable frequency and displacement are reported. Synchronous detection of the indoor pressure signal created by the source eliminates the noise due to fluctuations caused by the wind. Comparisons are presented between these results and extrapolations of direct fan leakage measurements.

5894 (PB—289927) **Climate data abbreviation for the computerized calculation of heating and cooling requirements in buildings.** Arens, E.A.; Nall, D.H. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Dec 1978. 67p. NTIS PC A04/MF A01.

This report documents the development of a climate data abbreviation technique for building thermal analysis. It discusses the characteristics of computerized building thermal simulations and the requirements for abbreviated data. The technique is then described together with the statistical analyses used to develop it. A series of tests of the representativeness of the abbreviated climate data are documented and the limitations and potentials of the abbreviation technique are discussed.

5895 (SAND—79-2050C) **Wind data application in developing the ANSI A58.1-1980 standard.** Church, H.W. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 9p. (CONF-791129—1). Dep. NTIS, PC A03/MF A01.

From Workshop on wind climate; Ashville, NC, USA (11 Nov 1979).

The American National Standards Institute (ANSI) standard on minimum design loads in buildings and other structures has recently undergone a routine review and revision. A critical pat of this review involved an analysis of climatological wind data collected at National Weather Service Stations throughout the country. A general description is given of the various steps taken in this analysis including data selection criteria and collection, data reduction and statistical analysis, wind field analysis and special regions consideration. It is concluded that while the wind data are probably not of the quality desired, sufficient information is available to produce a guide useful for assessing structural design loads.

5896 **LiCl dehumidifier/LiBr absorption chiller hybrid air conditioning system with energy recovery.** Ko, S.M. (to Dept. of Energy). US Patent Application 966,524. 4 Dec 1979. 30p.

The invention relates to a hybrid air conditioning system that combines a solar powered LiCl dehumidifier with a LiBr absorption chiller. The desiccant dehumidifier removes the latent load by absorbing moisture from the air, and the sensible load is removed by the absorption chiller. The desiccant dehumidifier is coupled to a regenerator and the desiccant in the regenerator is heated by solar heated hot water to drive the moisture therefrom before being fed back to the dehumidifier. The heat of vaporization expended in the desiccant generator is recovered and used to partially preheat the driving fluid of the absorption chiller, thus substantially improving the overall COP of the hybrid system.

RESIDENTIAL BUILDINGS

5897 (CONF-790661—2) **Fuel choice and aggregate energy demand in the residential and commercial sectors of the US.** Cohn, S.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 49p. Dep. NTIS, PC A03/MF A01.

From Western Economics Association annual meeting; Las Vegas, NV, USA (17 Jun 1979).

The residential and commercial sectors are important energy consumers in the US economy, consuming approximately 35% of total national energy use in 1975. Specifically, this studies' objectives are: (1) to develop aggregate energy demand models for both the residential and commercial sectors, and (2) to develop multinomial logit models of fuel choice for both sectors from which the demands for individual fuels (electricity, natural gas, and fuel oil) are estimated. Both short- and long-run market share and conventional fuel demand elasticities are analytically derived with the impact of inter-fuel substitution analyzed for the two sectors separately. The fuel choice models utilize constrained price ratio coefficients to conform with established logit theory. In addition, fuel price variables other than the own-price and numeraire price are included in this logit model. Explanatory variables representing the capital stock of energy using equipment in the commercial sector and the availability of natural gas are included in the aggregate energy demand and fuel choice models to improve their specification. The models are estimated with improved data (pooled time series and state level) which allocate to the residential sector the master-metered electricity and natural gas use components that traditional energy consumption data sources assign to the commercial sector. In addition, household and commercial distillate fuel oil use is differentiated on a state-by-state basis.

5898 (CONS—0003-T1) **How to start a utility residential energy conservation program.** Aochi, S.K. (Northern California Power Agency (USA)). Jun 1979. Contract EW-78-G-49-0003. 199p. Dep. NTIS, PC A09/MF A01.

This report describes the activities of the first year of operation of the California Municipal Utility Residential Energy Conservation Project. The Project, designed to foster residential energy conservation through the cooperative efforts of small utilities, is a five-year program of the Northern California Power Agency (NCPA), a group of eleven municipal utilities and one rural electric cooperative. First-year funding of a planned five-year grant has been provided by the US Department of Energy in cooperation with the California State Energy Commission. Part I delineates the goals for year one, including the development of retrofit insulation and financing programs, and the progress made toward reaching those goals. Part II describes program implementation in the first NCPA grant-funded city, Palo Alto, California, including the customer-incentive methodology employed. Part III is an exhibit of the forms, procedures, and publicity Palo Alto developed for its Weatherization Program. The concluding Part IV discusses the results of the Palo Alto program. The main conclusion is that utilities, no matter how small or whether they are investor-owned or publicly-owned, can successfully develop and implement residential energy conservation programs.

5899 (CONS—4161-T1) **Pilot aerial infrared roof top survey. Final report.** (Minnesota Energy Agency, St. Paul (USA)). 15 Oct 1979. Contract EC-77-C-02-4161. 55p. Dep. NTIS, PC A04/MF A01.

A summary is presented of a pilot aerial infrared roof top study conducted by the Minnesota Energy Agency. Infrared surveys of 27 Minnesota cities were conducted during the fall and winter of the 1976-1977 heating season. In addition, conventional daytime color photographs were taken of several cities. Film processing was done by the Environmental Protection Agency. The University of Minnesota conducted ground tests to verify the aerial infrared imagery. Thermograph dissemination centers were established in each city and training seminars and materials were prepared and delivered to dissemination center staff. A survey of homeowners who viewed their thermograph at a dissemination center were used to determine the energy savings resulting from the program. An Aerial Infrared Program Users Manual was prepared by the Energy Agency and the Remote Sensing Institute of Brookings, South Dakota.

OFFICE BUILDINGS

5900 (COO—2704-T2) **Air change measurements using a tracer gas technique.** Doeffinger, R.C. (Pennsylvania State Univ., University Park (USA). Dept. of Architectural Engineering). Mar 1976. Contract EY-76-S-02-2704. 37p. Dep. NTIS, PC A03/MF A01. Thesis.

The air change rate in a single story office building was measured using a tracer gas technique. The air change rate was determined by the rate of decay method using sulfur hexafluoride as the tracer gas. A total of eight tests were conducted within a 48-h period under small temperature differences and wind velocities. Building conditions were investigated with supply ventilation fan on, producing a positive pressure in the building, and with supply ventilation fan off. Both multipoint sampling, and single-point return air sampling techniques were used. From this research an effective technique was developed for calibrating portable gas chromatographs. For this particular building, tests showed that the single-point return air sampling technique compared favorably with the multi-point sampling technique. With the limited number of tests, no empirical relationship between temperature difference, pressure difference and air change rate could be developed, although certain trends were established.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

5901 (AD-A—064350) **Energy conservation options at the Naval Air Station, Moffett Field. Technical note.** Colah, M.S.; Schubert, W. (SRI International, Menlo Park, CA (USA)). Jan 1979. Contract N62474-78-C-0789. 62p. NTIS, PC AA04/MF A01.

Defense support installations, such as shipyards, air stations, training centers, and communications stations, provide support to the combat units of the United States that is essential to the maintenance of the operational readiness of those units. As a result of recent events, these installations are highly vulnerable to the rapidly increasing costs of energy forms, to possible decreases in the general quality of available energy forms, and to any politically-motivated manipulation of energy production, deliveries, and prices. The need for carefully planned and decisively executed action by the military services to reduce this vulnerability is clearly evident. Improvements are needed both in systems and facility design and in operational and training doctrine to conserve the use of energy and to adapt to the use of more plentiful energy forms, while at the same time being careful not to produce unacceptable impacts on the combat readiness of our military forces and their costs.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 5897

5902 (OA-tr—2147) **Heating, ventilation, and air-conditioning of industrial premises by means of air-to-air heat pumps on the roof.** Galland, D. (Electricite de France, 75 - Paris. Service d'Etude et de Promotion de l'Action Commerciale). [nd]. Translation of PAC-Industrie, No. 3, 1-10, 1976. 12p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The considerations and information acquired over a number of years of practical study of heating and air-conditioning of industrial premises by air-to-air heat pumps located on the roof are presented. This is illustrated with examples of practical cases together with calculated results. It is concluded from this study that the use of the air-to-air heat pump located on the roof for heating, ventilation, air-conditioning of industrial premises permits heat recovery, a large saving of energy due to the efficiency of the equipment, a saving in floor area by eliminating a boiler house and reduced engineering shops, ambient conditions and an environment that is clean and pollution-free, better comfort for the workshop staff, and only one energy source, i.e., electric power. (LCL)

5903 (ANL/CNSV-TM—19(Vol.1)) **Philadelphia's Gallery II shopping center complex: an analysis for the application of an integrated community energy system .** Lee, C.; Davis, A.; Kron, R. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 26p. Dep. NTIS, PC A03/MF A01.

The results of ANL's study of the energy and economic aspects of energy system options for the Gallery II development are reported. Gallery II is a 1.3 million ft^2 office and shopping complex to be built in downtown Philadelphia. Seven centralized energy system alternatives, including five total energy systems and two heat-pump systems, were analyzed and compared with a decentralized, all-electric, conventional system. Comparisons among systems indicate that, in today's economy, the heat-pump-centered system which redistributes heat among different zones of buildings through the operation of heat pumps can achieve significant energy and economic savings.

5904 (ANL/CNSV-TM—19(Vol.2)) **Philadelphia's Gallery II shopping center complex: an analysis for the application of an integrat-**

ed community energy system. Vol. 2: complete data report. Lee, C.; Davis, A.; Kron, R. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 65p. Dep. NTIS, PC A04/MF A01.

Detailed findings and calculations of Argonne's study of energy systems for the Gallery II commercial complex in Philadelphia are presented. The presentation includes design demands, service demand profiles, and descriptions of the seven alternative energy systems considered for Gallery II. The energy system descriptions include schematics, equipment used, energy-use calculations, equipment costs, operation and maintenance costs, and energy costs.

5905 (DOE/EIA—0183/12) **Industrial-boiler costs: a comparison of recent studies.** Cohen, B.; Glixon, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Sep 1979. 17p. Dep. NTIS, PC A02/MF A01.

This paper compares and contrasts three recent industrial-boiler cost studies. It emphasizes the variability in boiler cost estimates, sources of this variability and consequences for modeling and analysis activities. Among the studies considered, the direct capital cost (excluding air-pollution-control equipment) of a coal-fired unit varied significantly. At one extreme, the coal boiler cost varied significantly. At one extreme, the coal boiler cost nearly five times that of an oil-fired boiler; at the other extreme, it cost less than two and-one-half times that of an oil unit. Cost-estimate differences of this magnitude could have major consequences for industrial fuel-mix projections and policy analysis. If the high cost estimates were used in a policy analysis effort, far-more-stringent regulations might be required to promote industrial coal use than if the lower coal-cost estimates were used. This report highlights the need for standardizing the basis for comparative studies of the industrial-boiler fuel-choice decision.

5906 (PB—289837) **Conservation where it counts: energy management systems. Final report.** Foley, D. (California Energy Commission, Sacramento (USA)). Jan 1978. 14p. NTIS PC A02/MF A01.

This report aids managers of commercial buildings or industrial plants in identifying energy waste and controllable energy loads, and in choosing the right load control system for heating, ventilating, and air conditioning (HVAC) equipment. A method for calculating a building's energy budget is explained, and the U. S. General Services Administration energy budget guideline is given as a comparison. Energy saving equations are provided to help establish realistic energy waste reducing goals. Techniques for reducing the operating time of lights and HVAC equipment -- demand limit load shedding, optimization of equipment running time, fixed start-stop schedules, and load cycling -- are discussed. The various types of control equipment, from elaborate central mini-computer or micro-computer systems to simpler and less expensive programmable controllers or disbursed black box systems, are described, and approximate purchase costs are given. Checklists for comparing hardware costs are included.

TRANSPORTATION

AIR AND AEROSPACE

5907 (AD-A—064378) **A proposed aviation energy conservation program for the National Aviation System. Final report.** (Federal Aviation Administration, Washington, DC (USA). Office of Aviation Policy). Nov 1978. 33p. NTIS, PC AA03/MF A01.

This study presents an overview of potential options for improving aviation energy efficiency. Included in the proposed program are alternatives that could be pursued by the Federal Government as well as options that could be adopted by the various segments of the aviation industry. The report is in four volumes: Volume I - The Short Run, 1977-1978; Volume II - The Intermediate and Long Run, 1979-1990; Volume III - The Proposed Aviation Energy Conservation Program; and Summary - Overview of preceding technical volumes. (Author)

5908 (AD-A—064379) **A proposed aviation energy conservation program for the National Aviation System. Volume I. The short run, 1977-1978. Final report.** (Federal Aviation Administration, Washington, DC (USA). Office of Aviation Policy). Nov 1978. 77p. NTIS, PC AA05/MF A01.

This study presents an overview of potential options for improving aviation energy efficiency. Included in the proposed program are alternatives that could be pursued by the Federal Government as well as options that could be adopted by the various segments of the aviation industry. The report is in four volumes: Volume 1 - The Short Run, 1977-1978; Volume 2 - The Intermediate and Long Run, 1979-1990; Volume 3 - The Proposed Aviation Energy Conservation Program; and Summary - Overview of preceding technical volumes. (Author)

5909 (AD-A—064466) **A proposed aviation energy conservation program for the National Aviation System. Volume II. The intermediate and long run, 1979-1990. Final report.** (Federal Aviation Administration, Washington, DC (USA). Office of Aviation Policy). Nov 1978. 83p. NTIS, PC AA05/MF A01.

This study presents an overview of potential options for improving aviation energy efficiency. Included in the proposed program are alternatives that could be pursued by the Federal Government as well as options that could be adopted by the various segments of the aviation industry. The report is in four volumes: 1 - The Short Run, 1977-1978; 2 - The Intermediate and Long Run, 1979-1990; 3 - The Proposed Aviation Energy Conservation Program; and Summary - Overview of preceding technical volumes. (Author)

5910 (AD-A—064623) **A proposed aviation energy conservation program for the national aviation system. Volume III. The proposed aviation energy conservation program. Final report.** (Federal Aviation Administration, Washington, DC (USA). Office of Aviation Policy). Nov 1978. 87p. NTIS, PC AA05/MF A01.

This study presents an overview of potential options for improving aviation energy efficiency. Included in the proposed program are alternatives that could be pursued by the Federal Government as well as options that could be adopted by the various segments of the aviation industry. The report is in four volumes: Volume I - The Short Run 1977-1978, Volume II - The Intermediate and Long Run, 1979-1990, Volume III - The Proposed Aviation Energy Conservation Program, Summary - Overview of preceding technical volumes. (Author)

5911 (SAN—2184-T2) **Examination of commercial aviation operational energy conservation strategies.** Covey, R.R.; Mascetti, G.J.; Roessler, W.U. (Aerospace Corp., El Segundo, CA (USA)). Oct 1978. Contract EM-78-C-03-2184. 327p. Dep. NTIS, PC A15/MF A01.

This report identifies 47 fuel conservation strategies for commercial aviation and examines the fuel saving potential, costs, constraints, and current implementation levels of these options. This assessment is based on a comprehensive review of published data and discussions with representatives from industry and government. Analyses were performed to quantify the fuel saving potential of each option, and to assess the fuel savings achieved to date by the airline industry. Those options requiring further government support for option implementation were identified, rated, and ranked in accordance with a rating methodology developed in the study. Finally, recommendations are made for future government efforts in the area of fuel conservation in commercial aviation.

RAILWAY

REFER ALSO TO CITATION(S) 5329

5912 (DOE/PE/8628—1(Vol.1)) **Analytical procedures for urban transportation energy conservation: summary of findings and methodologies.** Suhrbier, J.H.; Byrne, W.D. (Cambridge Systematics, Inc., MA (USA)). Oct 1979. Contract EM-76-C-01-8628. 54p. Dep. NTIS, PC A04/MF A01.

Analytical methodologies are described and illustrated for use by metropolitan planning organizations and other state and local transportation agencies in analyzing the energy conservation potential of candidate urban transportation measurements. Quantitative methodologies oriented to carpooling, vanpooling, transit, pricing, traffic regulation and control, and auto ownership are provided based on the use of disaggregate behavioral travel demand models. Changes are indicated in trip frequency and distribution as well as in travel model, operating conditions, and vehicle miles of travel. Trip-based estimates of fuel consumption and vehicle emissions are included. The methodologies can be adapted to different levels and types of data availability, and can employ manual sketch planning procedures, a programmable calculator, or a fully-calibrated computer program utilizing a random sample household enumeration forecasting technique. Application of the developed methodologies has been performed in cooperation with metropolitan planning organizations representing the Dallas-Fort Worth, San Francisco, and Denver urban areas.

5913 (DOE/PE/8628—1(Vol.3)) **Urban transportation energy conservation: case city applications of analysis methodologies.** Atherton, T.J.; Suhrbier, J.H. (Cambridge Systematics, Inc., MA (USA)). Oct 1979. Contract EM-76-C-01-8628. 160p. Dep. NTIS, PC A08/MF A01.

This report demonstrates the application of a set of disaggregate travel demand methodologies to the analysis of potential energy conservation strategies in three urban areas: Denver, Colorado; Fort Worth, Texas; and San Francisco, California. The methodologies are sketch planning in nature and include the forecasting of changes in automobile ownership; work trip model shares by drive alone, shared ride, and transit; non-work trip frequency, destination, and

mode choice; fuel consumption and vehicle emissions. Using concepts of market segmentation and random sample household aggregation, both computer system and manual worksheet versions of the basic approach are applied. Policies analyzed include those related as employer based ride sharing, parking management, transit, pricing, and traffic operations. Considerable variations in the potential effectiveness was found, among the three urban areas, depending in large part on the availability of alternative travel modes such as transit. Descriptions are provided of the individual policy analyses performed, the methods by which example policies were analyzed, the necessary data preparation activities, and the procedures used to adapt the set of travel demand models to the unique conditions of each of the three metropolitan areas.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 5855, 5912, 5913

5914 (ANL/CNSV-TM—22) **Projections of automobile, light truck, and bus stocks and sales, to the year 2000.** Knorr, R.; Millar, M. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 66p. Dep. NTIS, PC A04/MF A01.

Future stocks and sales of automobiles, light trucks, and buses are projected in this document. Automobile projections are developed for fleet and non-fleet sectors. Total auto stock is projected as a function of the number of households and of personal income, with adjustment for present and anticipated shifts from automobiles to light trucks. Automobile stocks and sales are projected to increase steadily through the year 2000 with a slightly larger growth rate associated with fleet autos. Projections of light-truck stocks and sales are developed for personal, service/utility, agriculture, manufacturing, government, wholesale/retail, and other uses based on anticipated employment and output for each of the use sectors. Projections anticipate the largest growth area to be that of personal light trucks. Bus stocks and sales are projected as a function of user populations, existing fleet characteristics, and anticipated usage patterns. School, intercity, and transit buses are included in the study. School buses are projected to have the largest percentage of growth in this sector.

5915 (DOE/PE/8628—1(Vol.2)) **Urban transportation energy conservation: analytic procedures for estimating changes in travel demand and fuel consumption. Final report.** Atherton, T.J.; Suhrbier, J.H. (Cambridge Systematics, Inc., MA (USA)). Oct 1979. Contract EM-76-C-01-8628. 153p. Dep. NTIS, PC A08/MF A01.

This series of reports provides metropolitan planning organizations with analytical tools that can be used to evaluate the effectiveness of alternative transportation policies in achieving reductions in overall fuel consumption. To ensure a high measure of accuracy, the analysis goes beyond the first order effects, i.e., the shift from single occupant autos as the mode chosen for the work trip to more fuel efficient means of travel. Questions treated include what will happen with the autos left at home as a result of increased carpooling for work trips. Will certain policies, such as gasoline price increases, directly impact non-work tripmaking. Will a particular transportation policy affect all segments of the population, or will certain groups be impacted significantly more than others. The methodology developed links together several disaggregate travel demand models to predict auto ownership, work trip mode choice, and non-work travel demands. This report introduces the theoretical basis for the travel demand models used, describes these models and their linkages both with each other and with the various submodels, and documents the assumptions made in developing the model system and using it to forecast responses to alternative transportation policies. Emphasis is placed on the conceptual framework of the model system and specification of the individual models and submodels.

5916 (DOE/PE/8628—1(Vol.4)) **Urban transportation energy conservation: analysis of traffic engineering actions.** (Cambridge Systematics, Inc., MA (USA)). Oct 1979. Contract EM-76-C-01-8628. 72p. Dep. NTIS, PC A04/MF A01.

The interrelationships among highway supply, vehicular travel demand, and vehicular fuel consumption are systematically considered using empirical data from Denver and San Francisco. A determination is made of the degree to which fule savings produced by more-efficient vehicle operation on city streets and freeways are offset by the additional fuel consumed by either longer or new vehicular travek, developing in the process an analytical framework, step-by-step procedure, and a base of empirical data that can be easily applied in other urban areas. The principal finding is that where comprehensive application of state-of-the-art techniques for improved traffic conrol of signalized urban arterials and freeways can be used to improve areawide travel time on the order of 10%, the energy savings attributable to this improved quality of flow are substantially less than offset by short-range induced increases in travel. Net energy savings produced are approximately 3% for the two cases analyzed. Further, these estimated savings are of the same order of magnitude as the savings obtainable through the application of measures directed primarily at reducing the demand for vehicular travel. This finding is counter to some recent thinking in which any improvement in highway supply is deemed undesirable from an energy conservation viewpoint since the change is seen as only inducing more travel.

5917 (DOE/PE/8628—1(Vol.5)) **Urban transportation energy conservation. SRGP operating instructions and program documentation. Final report.** MacMann, J.F.; Nestle, R.E. (Cambridge Systematics, Inc., MA (USA)). Oct 1979. Contract EM-76-C-01-8628. 120p. Dep. NTIS, PC A06/MF A01.

SRGP is a computer program for Short Range Generalized transportation Policy analysis for use in analyzing the energy conservation potential of a broad spectrum of transit, carpooling, vanpooling, parking, pricing, and other transportation system management measures. It is intended for use in either an areawide or corridor context and in what is referred to as a sketch planning style of analysis. Outputs include changes in fuel consumption, vehicle emissions, vehicle miles of travel and modal shares for drive alone, shared ride, and transit. Changes in travel behavior are forecast relating to auto ownership, work trip mode choice, and the frequency, destination, and mode choice for both shopping and social/recreational non-work travel. Using a random sample household forecasting procedure, SRGP is a modified version of the program UMODEL, distributed by the US Urban Mass Transportation Administration as part of UTPS, the Urban Transportation Planning System.

5918 (PB—289962) **Categorization and characterization of american driving conditions (phase 1). Final report, October 1977-July 1978.** Joksch, H.C.; Reidy, J.C. Jr. (Center for the Environment and Man, Inc., Hartford, CT (USA)). Nov 1978. Contract DOT-TSC-1419. 198p. NTIS PC A09/MF A01.

The objectives of the study were: (1) to develop a multidimensional matrix as an analysis framework to classify travel of personal motor vehicles according to fuel consumption, (2) to identify and assess available information on travel and fuel consumption, and (3) to describe how to use specific information for quantifying the matrix. A review of the fuel economy literature revealed a large number of factors which influence fuel consumption. Only some of these factors were related to driving conditions. The factors categorizing driving conditions were selected according to their independence, their relationship to fuel consumption, and their interest for studying fuel economy policies. They are: trip purpose, trip length, time, geographic area, highway class and vehicle class and model year. Fuel consumption rates can be estimated from vehicle and trip characteristics including trip length, ambient temperature and average trip speed. Promising statistical methods for quantifying the matrix were identified; however, some aspects of estimating error cannot be addressed without an analysis of the actual data. A plan for implementing this methodology is presented. Illustrative examples of a scaled down matrix and its use are presented in appendices.

5919 (PB—290372) **Current transportation issues in the United States. Volume I: executive summary.** (National Transportation Policy Study Commission, Washington, DC (USA)). Sep 1978. 48p. NTIS PC A03/MF A01.

The report discusses 25 major issues in transportation. Issues were derived from the Commission's literature review, survey, and public hearings. Volume I briefly summarizes the issue identification process and the issues. Volume II provides a detailed review of past transportation studies, a summary of survey and hearing results, and a discussion of the background and importance of each issue. The issues discussed affect many areas of transportation including government regulation, jurisdiction, planning, finance, energy, environment, labor, safety, and equity.

5920 (UMTA-CA—06-0095-79-1) **Golden Gate Vanpool Demonstration Project.** Dorosin, E.; FitzGerald, P.; Richard, B. (Crain and Associates, Menlo Park, CA (USA)). Jul 1979. 301p. Department of Transportation, Urban Mass Transportation Adm., Washington, DC.

This is an interim report covering the Golden Gate Vanpool Demonstration project during the first eight months of operation. The purpose of this UMTA-funded Service and Methods Demonstration is (1) to test a public agency's ability to form vanpools and (2) to test the feasibility of transitioning vanpoolers from project vans into private vanpool arrangements. The report describes operating characteristics and documents planning implementation stages. Analyses of service levels, demand, productivity, marketing strategies, and vanpooler demographics are presented.

SEA AND WATER

REFER ALSO TO CITATION(S) 5329

PIPELINE

REFER ALSO TO CITATION(S) 5329

INDUSTRY AND AGRICULTURE

ENERGY SOURCES

5921 **Dairy-energy connection.** Washington, DC; National Independent Dairies Association (1979). 129p. (DOE/TIC—11015). $10.00.

A 20 to 30% net energy cost reduction in the dairy is possible by applying the recommendations in this handbook. The reduction can be achieved without lowering product quality and without affecting employee morale or customer satisfaction. Fifteen recommendations are given for processing products; 6 measures for conserving energy in product transport; and 3 measures each for lighting and heating. (MCW)

5922 (PB—293014) **Industrial boilers - fuel switching methods, costs, and environmental impacts. Final report.** Burke, J.M.; Matson, M.D. (Radian Corp., Austin, TX (USA)). Dec 1978. Contract EPA-68-02-2608. 182p. NTIS, PC AA09/MF A01.

The potential for existing boilers to switch fuels from natural gas or oil to oil, coal, or a coal derived fuel is examined. Twenty possible fuel switching scenarios are identified. The technical aspects of switching fuels, the capital and operating costs, and the environmental effects are discussed. The influence of legislation such as the Energy Supply and Environmental Coordination Act of 1974 (ESECA), the Energy Policy and Conservation Act of 1975 (EPCA), and the National Energy Plan, is considered.

MATERIALS

5923 (PB—290338) **Evaluation of technical material and information for potential desalting demonstration plants. Final report.** Furukawa, D.H.; Frank, K.F.; Mannion, R.E.; Papadopoulos, E.; Ryan, T.C. (Boyle Engineering Corp., San Diego, CA (USA)). Dec 1978. Contract DI-14-34-0001-8705. 210p. NTIS PC A10/MF A01.

An evaluation was conducted of technical information and material provided by applicants to the OWRT Desalting Demonstration Plant Program. The program was authorized by Public Laws 95-84 and 95-467 to demonstrate the state-of-the-art in desalting technology. The evaluation was conducted based on eight criteria: Interest and Commitment; General Site Considerations; Consideration of Desalting Needs; Demographic and Socio-Economic Considerations; Water Supply Considerations; Financial Considerations; Energy Considerations; and Environmental Considerations. Thirty-seven sites were evaluated during this study. The applicant sites represent 17 states and the Virgin Islands, and have a wide variety of water problems which were grouped into 5 categories: Inland Brackish Groundwater; Seacoast; Island; Wastewater for Secondary Reuse; and Wastewater for Potable Use. The sites were ranked by raw cumulative score and by individual category. Sites with critical water needs were identified in both small and large cities. Each of the sites evaluated represents a genuine potential site for a desalting demonstration plant.

EQUIPMENT AND PROCESSES

5924 (DOE/FE/2471—39) **Industrial application fluidized bed combustion: category III indirect fired heaters. Quarterly technical report No. 12, April 1-June 30, 1979.** (Exxon Research and Engineering Co., Florham Park, NJ (USA). Engineering Technology Dept.). Oct 1979. Contract EX-76-C-01-2471. 131p. Dep. NTIS, PC A07/MF A01.

A program is underway to evaluate the technical and economic potential for the application of fluidized bed combustion to refinery and petrochemical plant indirect fired process heaters. Two pertinent areas which are being investigated concern the effect of larger tube size and hydrocarbon coking. Phase I of the program consists of the design, construction, and operation of three laboratory facilities to carry out these studies. Fluidized bed performance studies, including bed mixing and density measurement, were completed on six alternative tube bundle configurations ranging from 2-in to 6-in dia tubes arranged on nominal 2-dia, 3-dia, and 4-dia horizontal spacing. Conductive-convective heat transfer coefficients as a function of tube size, location, and surface orientation were also obtained on these same bundle configurations and on isolated single tubes. Finally, evaluations were made on the effect of altering the tube-to-grid dimensions and of operating with limestone beds of different particle size distributions. A Process Stream Coking Test Unit was used to study the parameters affecting coke laydown on the internal surfaces of hydrocarbon containing tubes under conditions of high temperature and heat transfer rate. The data analysis shows that in addition to film temperature, mass velocity is an important parameter in controlling coking rate. No coke laydown occurred in any tests run at a mass velocity of 600 lb/sec ft^2 at heat fluxes up to 60,000 Btu/hr ft^2. A complete analysis of the test results is presented. Construction of the High Temperature Heat Flux Test Unit was completed. The Economic Assessment of the Program is now underway. If these assessments plus the technical data obtained in the laboratory R and D phase of the program indicate favorable commercial potential, the program will be advanced to the demonstration phase.

5925 (DOE/TIC—11014) **Energy cost reduction in the baking industry.** (American Bakers Association, Washington, DC; Retail Bakers of America, Hyattsville, MD (USA)). 1979. 127p. Dep. NTIS, PC A07/MF A01.

Information is presented on methods for saving fuel and electric power in the baking industry; the cost of specific retrofits to bakery equipment and of modifications to processes; ways to reduce transportation costs and energy; and reducing energy demand for lighting, cooling, and heating bakeries. (LCL)

5926 (ORNL/TM—6970) **Materials analyses of ceramics for glass furnace recuperators.** Weber, G.W.; Tennery, V.J. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 115p. Dep. NTIS, PC A06/MF A01.

The use of waste heat recuperation systems offers significant promise for meaningful energy conservation in the process heat industries. This report details the analysis of candidate ceramic recuperator materials exposed to simulated industrial glass furnace hot flue gas environments. Several candidate structural ceramic materials including various types of silicon carbide, several grades of alumina, mullite, cordierite, and silicon nitride were exposed to high-temperature flue gas atmospheres from specially constructed day tank furnaces. Furnace charging, operation, and batch composition were selected to closely simulate industrial practice. Material samples were exposed in flues both with and without glass batch in the furnace for times up to 116 d at temperatures from 1150 to 1550°C (2100 to 2800°F). Exposed materials were examined by optical microscopy, scanning electron microscopy, energy dispersive x-ray analysis, x-ray diffraction, and x-ray fluorescence to identify material degradation mechanisms. The materials observations were summarized as: Silicon carbide exhibited enhanced corrosion at lower temperatures (1150°C) when alkalies were deposited on the carbide from the flue gas and less corrosion at higher temperatures (1550°C) when alkalies were not deposited on the carbide; alumina corrosion depended strongly upon purity and density and alumina contents less than 99.8% were unsatisfactory above 1400°C; and mullite and cordierite are generally unacceptable for application in soda-lime glass melting environments at temperatures above 1100°C.

WASTE HEAT RECOVERY AND UTILIZATION

5927 (CONS—1672-T1) **Recuperative system for high and ultra-high temperature flue gases. Final report.** Reitz, J.G.; Coeling, K.J.; Thekdi, A.C. (Midland-Ross Corp., Toledo, OH (USA). Technical Center - Thermal Systems). 31 Jan 1979. Contract EC-77-C-07-1672. 156p. Dep. NTIS, PC A08/MF A01.

Advanced recuperative system technology for high and ultra-high temperature flue gases was investigated. Several high temperature recuperator system and component concepts were evolved and studied for the purpose of finding the schemes and designs that attain maximum fuel savings. The most promising concepts for industrial application were pre-engineered further to devise designs for adaptation to existing steel mills. The principal effort was aimed at steel soaking pit applications. The concept which provides the highest air preheat temperatures and the largest fuel savings for soaking pit application utilizing basic state-of-the-art technology is a low air pressure ceramic recuperator operated in conjunction with a higher air pressure metallic recuperator. This concept has the additional advantage that higher air pressures can be attained at the burner than can be attained with an all ceramic recuperator. These higher air pressures are required for high momentum, high efficiency burner performance, resulting in improved productivity and additional fuel savings. The technical feasibility of applying this high temperature recuperation system to existing soaking pits was established.

5928 (ORNL/TM—7099) **Input-output analysis of various elements of an energy-agro-waste complex.** (Cal Recovery Systems, Inc., Richmond, CA (USA)). Nov 1979. Contract W-7405-ENG-26. 161p. Dep. NTIS, PC A08/MF A01.

The mass input and output streams of various agricultural and waste treatment processes were quantified and models developed to serve in the engineering analysis of potential waste heat utilization schemes. The unit process models can be integrated into energy-agro-waste complexes, in which waste heat from power plants is used by certain processes and the wastes of some processes are used as inputs to others. The models provide a means of determining the sizing or subsystems, the compatibility of subsystems, and the overall feasibility of an integrated complex. Ten potential complexes were qualitatively discussed and the considerations involved in forming such complexes explained. A mass balance analysis was performed on four integrated complexes demonstrating the engineering value of the analytical models developed.

5929 **Reradiant recuperator: development and demonstration.** Marnell, C.J. Chicago, IL; Institute of Gas Technology (1979). 11p. (CONF-791009—9).

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

The background and development of the reradiant concept for the radiant stack-type recuperator and the results of an ongoing demonstration program of this concept are presented. The reradiant recuperator increases the effectiveness of conventional radiant recuperators by 5% to 15% depending on the unit size. The mathematical model, which optimized the application of a metal leaf-type insert within the hot gases passing through a conventional radiant recuperator is described. The metal leaf insert is designed to maximize radiation to the annulus wall. This increase in heat transfer is not due to increased convective heat exchange, as when a core buster insert is used, but strictly due to radiation from the leaf insert. Data on a prototype unit operated to verify the mathematical model is presented and explained. Data collected from the current ongoing demonstration program (i.e., reradiant recuperators installed on industrial furnaces) will provide current data on the program.

5930 (OA-tr—2182) **Recovery of heat losses in induction furnace plants.** Kraus, R.; Richter, R. Translated from *BBC-Nachr.*; **58**: No. 5, 195-201(1976). 12p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Portions of document are illegible.

The heat lost in induction furnace plants can be used economically for heating purposes in other plant areas. Due to increasing energy costs, the required capital will pay off at an ever increasing rate. The possibilities of using the heat dissipated in a coreless induction furnace installation are discussed.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5379

5931 (PB—290126) **Energy conservation through source reduction. Final report.** Reid, G.W.; Khuong, C.H. (Oklahoma Univ., Norman (USA). Bureau of Water and Environmental Resources Research). Nov 1978. 76p. NTIS PC A05/MF A01.

This report deals with energy conservation through reduction in generation of post-consumer solid waste. The objective, scope, methodology and summary of the report are presented in Section 1. Section 2 contains the conclusions. Section 3 presents a review of output and input approaches to estimate the quantity and composition of post-consumer solid waste. Comparative notes on the two methods are included. Section 4 contains a compilation of estimates of energy consumed in the manufacture of discarded materials and in handling the solid waste. Section 5 studies potentials and possibilities of reducing refuse and estimates corresponding energy savings. Twenty examples of opportunities to reduce refuse at government, policy-maker, manufacturer, and consumer levels are proposed. The energy intensiveness of materials found in the waste stream, total energy residuals embedded in each material, and possible candidates for reduction with greatest energy savings are also presented.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 5543

5932 (CONF-7909103—1) **Community systems programs that may help small businesses survive in the 80's.** Clifford, D.W. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From Small business seminar; Chicago, IL, USA (28 Sep 1979).

In 1975, the Community Systems Program (CSP) was established in the Energy and Environmental Systems (EES) Division at Argonne for research in areas of community systems and their application. The work in EES includes research and long-range planning and development. Some of the work in the program is described and how it is applied in the local community is explained. The programs, if successful, will affect all economic levels. The basic premise behind the efforts is the saving of energy and cost reduction to the consumer. The Comprehensive Community Energy Management Program in the CSP involves 17 communities to determine local capability to organize and plan for the management and saving of energy. Other major efforts underway in CSP include the study of district heating and cooling systems, grid-connected community cogeneration, heat-pump applications, and the study of energy-efficient community design. These studies are on a large scale working with major developers, communities, and the utilities. These programs and their progress are described.

5933 (RLO—1002-T03) **Alaska Energy Project Phase II planning energy technologies for a new Alaska community. Final report.** (Alaska State Div. of Energy and Power Development, Anchorage (USA)). Oct 1978. Contract EY-77-C-06-1002-003. 214p. Dep. NTIS, PC A10/MF A01.

This document represents the final report of a study performed under contract with the US DOE by the State of Alaska and consultants on energy conservation techniques which were applied to their planning of a new community in the northern climates. The State of Alaska is planning to relocate its capital from Juneau to a site near Willow, Alaska. This Phase II study focused on the implementation of energy conservative systems into the comprehensive community plan for the New Capital City. Phase I primarily dealt with the identificaton of possible technologies and techniques and the methodologies to assess them. In order to impact the planning process, the energy planning team participated in the development of design determinants and guidelines, made energy source recommendations, and revised the state procurement process. Participation in the development of energy evaluation methodologies and criteria, as well as presenting our energy evaluation of the proposed alternative plans to the Planning Commission and general public, was a qualified success. The most important impact to the planning process was to cause the acceptance by the Commission and other consultants of the district heating technology and the expanded mass transportation system. Such energy saving technologies are now a part of the new community plan. Phase II results supported Phase I predictions that incorporation of applicable state-of-the-art technologies could mean a 40% energy savings.

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 5853, 5928

5934 (ANL/CES/TE—79-4) **Central heating: fossil-fired boilers.** Blazek, C.F.; Baker, N.R.; Tison, R.R. (Institute of Gas Technology, Chicago, IL (USA)). May 1979. Contract W-31-109-ENG-38. 92p. Dep. NTIS, PC A05/MF A01.

This evaluation provides performance and cost data for fossil-fuel-fired steam boilers, hot-water generators, and thermal fluid generators currently available from manufacturers. Advanced-technology fluidized-bed boilers also are covered. Performance characteristics investigated include unit efficiencies, turndown capacity, and pollution requirements. Costs are tabulated for equipment and installation of both field-erected and packaged units. The information compiled in this evaluation will assist in the process of selecting energy-conversion units required for industrial, commercial, and residential applications.

5935 (ANL/CNSV-TM—17) **Survey of available computer programs for district heating/cooling distribution systems.** (Stone and Webster Management Consultants, Inc., New York (USA)). Sep 1979. Contract W-31-109-ENG-38. 65p. Dep. NTIS, PC A04/MF A01.

A summary is given of the steps taken, contacts made, and results obtained from a survey conducted to locate computer programs that would be useful in the design and evaluation of district heating and cooling systems and to determine the level of computerization in this area. Documentation, which was available for each program, is reviewed to determine the general approach and area of application. Of interest in this study are existing distribution network computer programs for hot water, steam, chilled water, and natural gas.

5936 (COO—4213-1/2) **Grid-connected integrated community energy system. Volume II. Final report.** (Independence, City of, MO (USA)). Jul 1977. Contract EC-77-C-02-4213. 326p. Dep. NTIS, PC A15/MF A01.

A preliminary feasibility analysis of a grid-connected ICES in the City of Independence, Missouri, is presented. It is found that the ICES concept can be made feasible in Independence by employing a 20-MW coal-fired boiler and turbine and using waste heat to provide the energy for heating and cooling commercial facilities with over 3 million square feet of floor space. When fully loaded thermally, the ICES results in favorable fuel utilization and energy conservation in comparison to conventional energy systems. The City of Independence is experienced with all of the institutional factors that may impact the ICES Demonstration Project.

5937 (COO—4975-1) **District heating and cooling systems for communities through power plant retrofit and distribution network. Executive summary, September 1978-May 1979.** (Detroit Edison Co., MI (USA)). 15 Sep 1979. Contract EM-78-C-02-4975. 26p. Dep. NTIS, PC A03/MF A01.

Following DOE's RFP for District Heating and Cooling Through Power Plant Retrofit, Detroit Edison and the City of Detroit decided to respond, even though it would mean redirection and a delay in their plan that was already under study. The analysis reported here proceeded in six steps. The first step was to identify the service area under the constraint that it be within the City of Detroit and in close proximity to the candidate plant. With the basic

service area to be considered established, the load within the service area was defined for the five categories of end-users chosen: general residential, major residential, commercial, institutional, and industrial. Parallel to all tasks and continuing throughout the phase, a definition of institutional requirements - including regulatory, legal, and licensing aspects of a district heating and cooling project - was carried out to determine the ability of Detroit Edison to own and operate such a project and to define the limitations or problems that may be encountered in the project. The capacity of the retrofitted power plant to supply heating and cooling was determined as a basis for sizing the distribution systems and for determining which end-user loads could be served. The distribution systems were developed on an incremental basis to simulate the actual growth pattern of such a system, and were tested iteratively with the economic analysis to establish the optimum service area to produce the minimum cost to the end-user and a reasonable payback to the system owner. The economic analysis was performed based on matrices of cost parameters which determined the cost to the end-user, return to the system owner, and payback period for the system to determine the economic feasibility of the district heating and cooling system.

5938 (PB—289783) **Performance guidelines for a modular integrated utility system.** Mitchell, D.J. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Nov 1978. 93p. NTIS PC A05/MF A01.

This document defines generic performance of a MIUS serving a residential/commercial development. These performance requirements, criteria, and evaluations identify engineering parameters and other constraints associated with electrical service, thermal energy, solid waste management, potable water management, and wastewater management provided by a single, local, integrated source. There are also performance requirements, criteria, and evaluations for end-use considerations such as environmental impact, health, safety, and subjective acceptability.

5939 (COO—4981-1(Vol.1)(Exec.Summ.)) **District heating and cooling systems for communities through power plant retrofit and distribution networks. Phase I. Identification and assessment. Final report.** (Wisconsin State Energy Office, Madison (USA)). Sep 1979. Contract EM-78-C-02-4981. 38p. Dep. NTIS, PC A03/MF A01.

The study assesses the preliminary technical, economic, and institutional feasibility of district heating systems achieved by retrofitting existing utility power plants in three Wisconsin cities: Green Bay, Janesville/Beloit, and Madison. The overall approach consists of surveying the State of Wisconsin to identify all existing intermediate and base-loaded electric-generating facilities. Once identified, screening criteria are developed to narrow the list to the three most promising sites. For each of the three sites, an extensive market analysis is performed to identify and characterize thermal loads and survey potential users on their views and concerns regarding the concept. Parallel to this effort, each of the three sites is evaluated on its technical and institutional merits. The technical evaluation centers on identifying and evaluating utility plant retrofit schemes and distribution system alternatives to service the identified thermal market. The institutional analysis evaluates potential barriers such as environmental, distribution system right-of-way, and legal issues within the infrastructure of the state, city, and community. Finally, all previous aspects of the analysis are combined to determine the economic viability of each site. It is concluded that Green Bay is the most promising site.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 5672

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 5814, 5821, 5859

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

5940 (CONS—5181-1) **Advanced automotive propulsion systems: incentive financing.** (Bradford National Corp., Washington, DC (USA)). Feb 1979. Contract EM-78-C-01-5181. 60p. Dep. NTIS, PC A04/MF A01.

The purpose of this survey and study was to: review the available literature; contact developers, lending institutions, and other interested parties to determine their perceived need for Federal guarantees of financial obligations for AAPS research, development, demonstrations, and commercial availability; analyze the results; formulate conclusions; and make recommendations. A secondary purpose of the effort was to establish a dialogue with members of the automotive industry and the financial community which would facilitate development and rapid implementation of AAPS energy conservation programs. Results of the survey and study are presented. A background review of the complexities of advanced automotive propulsion systems and of financial incentives is presented in Section 2. Section 3 sets forth the methodology employed in developing the material for the report and reviews the information gathered through literature review, and individual and group discussions. The conclusions drawn from this information are summarized in Section 4, leading to the recommendations made in Section 5. Additionally, comprehensive appendices are provided for ready reference and ease in understanding the report.

5941 (DOE/CS—0069) **First annual report to Congress on the Automotive Technology Development Program.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). 31 Aug 1979. 6p. Dep. NTIS, PC A02/MF A01.

Progress in implementing the Automotive Propulsion Research and Development Act of 1978 is reported. (TFD)

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 5948

SPARK-IGNITION

REFER ALSO TO CITATION(S) 5485

DIESEL

REFER ALSO TO CITATION(S) 6155

TURBINE

5942 (DOE/NASA/0028—79/1) **Conceptual design study of an improved gas turbine (IGT) powertrain.** Johnson, R.A. (General Motors Corp., Indianapolis, IN (USA). Detroit Diesel Allison Div.). Jul 1979. Contract EM-78-I-01-4209. 238p. (NASA-CR—159604; DDA-EDR—9719). Dep. NTIS, PC A11/MF A01.

A study was conducted to establish the Conceptual Design of an Improved Gas Turbine (IGT) Powertrain which best meets the following goals: (1) at least a 20% improvement in fuel economy (as a result of powertrain thermal efficiency improvement) relative to a conventionally powered 1976 compact size passenger car, based on the EPA composite driving cycle; (2) 1983 production engineering readiness; (3) reliability and life comparable to those of currently marketed powertrains; (4) driverability acceptable to the consumer; (5) meet or exceed Federal Emission Standards of 0.4, 3.4, and 0.4 gm/mi for HC, CO, and NO/sub x/; (6) meet currently legislated noise and safety levels; and (7) have competitive initial cost and a life-cycle cost no greater than those of conventionally powered vehicles.

5943 **Regenerator for gas turbine engine.** Lewakowski, J.J. (to Dept. of Energy). US Patent 4,151,873. 1 May 1979. Filed date 25 Jan 1978. 4p.

PAT-APPL-872,204.

The rotary disc-type counterflow regenerator for a gas turbine engine includes a disc-shaped ceramic core surrounded by a metal rim which carries a coaxial annular ring gear. Bonding of the metal rim to the ceramic core is accomplished by constructing the metal rim in three integral portions: a driving portion disposed adjacent the ceramic core which carries the ring gear, a bonding portion disposed further away from the ceramic core and which is bonded thereto by elastomeric pads, and a connecting portion connecting the bonding portion to the driving portion. The elastomeric pads are bonded to radially flexible mounts formed as part of the metal rim by circumferential slots in the transition portion and lateral slots extending from one end of the circumferential slots across the bonding portion of the rim.

EXTERNAL COMBUSTION ENGINES

RANKINE CYCLE

5944 (COO—2701-1) **Design and development of an automotive propulsion system utilizing a Rankine cycle engine (water based fluid). Final report.** Demler, R.L. (Scientific Energy Systems Corp., Natick, MA (USA)). Sep 1977. Contract EY-76-C-02-2701. 364p. Dep. NTIS, PC A16/MF A01.

Under EPA and ERDA sponsorship, SES successfully designed, fabricated and tested the first federally sponsored steam powered automobile. The automobile - referred to as the simulator - is a 1975 Dodge Monaco standard size passenger car with the SES preprototype Rankine cycle automotive propulsion system mounted

in the engine compartment. In the latter half of 1975, the simulator successfully underwent test operations at the facilities of SES in Watertown, Massachusetts and demonstrated emission levels below those of the stringent federally established automotive requirements originally set for implementation by 1976. The demonstration was accomplished during testing over the Federal Driving Cycle on a Clayton chassis dynamometer. The design and performance of the vehicle are described.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 5485, 5947

5945 (DOE/TIC—10232) **Test and evaluation report of the ERDC Hybrid-Electric Van (HEVAN).** Klose, G.J. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1979. Contract EX-76-A-31-1011. 67p. Dep. NTIS, PC A04/MF A01.

The HEVAN or Hybrid-Electric Van is a battery-powered electric vehicle with an on-board gasoline-fueled electric power generation unit. The HEVAN was developed from a Volkswagen transporter chassis. It is propelled by a series-wound DC traction motor rated at 20 HP (14.9 kW) which is powered by sixteen 6-volt SGL lead-acid batteries of nominally 96 volts. The motor power is controlled by an SCR chopper with a bypass contactor and drives the vehicle through a four-speed VW transaxle. The conventional VW hydraulic brake system is used; there is no provision for regenerative braking. The on-board electric power generator consists of a 16-HP (11.9 kW) gasoline engine driving a 7.5 kW alternator with a DC rectifier; this provides electrical power either directly to the drive motor or to the battery pack, depending on the battery charge state and the motor power requirements. The HEVAN series hybrid was shipped to JPL in Pasadena, California, where test instrumentation was installed. The test weight of 2327 kg (5130 lb) includes a lead-acid battery pack of 500 kg (1100 lb). Numerous tests were conducted with pure-electric operation, but only limited results were obtained in the hybrid mode due to continual problems with the motor-generator set.

5946 (UCID—18320) **Energy storage systems for automobile propulsion.** O'Connell, L.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1979. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

The research on electrically-fueled highway vehicles that can be used as general-purpose vehicles identifies and evaluates energy-storage devices for use in automobiles and determines which energy-storage power systems are credible alternatives to the present internal-combustion-engine system. Performance of the task is outlined. The energy-storage propulsion systems can be divided into three categories: electricity utilization, alternative fuel utilization, and petroleum fuel-economy improvement. Results are specifically discussed for electricity utilization. It is concluded that automotive electrical power systems can be developed for various performance levels; most energy-storage vehicles or electricity-using vehicles will weigh more and cost more than their internal-combustion-engine equivalents; if performance of these vehicles is reduced, then they can be more cost-competitive with today's internal-combustion-engine vehicle; all advanced energy-storage devices and vehicles are high-risk developments; no future battery system of those remaining can be projected as a clear choice for development, given the present state-of-the-art and the uncertainties of future battery characteristics; and pure mechanical-energy-storage propulsion systems will not have sufficient specific energy for most vehicle applications. These devices, specially flywheels, do appear useful as power boosters for both electric and hybrid vehicles in certain mission applications. (MCW)

HYBRID SYSTEMS

5947 (UCRL—15138) **Mechanical energy storage technology for transportation applications project plan.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 30 Nov 1979. Contract W-7405-ENG-48. 50p. Dep. NTIS, PC A03/MF A01.

The general objective of the project is to provide safe and economical flywheel systems for regenerative braking and load leveling in electric and other hybrid vehicles by FY 1984. For eventual utilization in vehicles, the design of FES technology must be both functional and marketable. The use of FES regenerative braking and load leveling systems will upgrade the performance of electric and hybrid vehicles and improve the fuel economy of heat engine/flywheel vehicles to a level required for acceptable market penetration. However, the extent to which market acceptance depends on performance has not been determined.

FLYWHEEL PROPULSION

REFER ALSO TO CITATION(S) 5947

EMISSION CONTROL

5948 (PB—287038) **Application for certification for 1978 model year light-duty vehicles - Ford Motor Company.** (Ford Motor Co., Dearborn, MI (USA)). 3 May 1978. 288p. NTIS, PC AA21/MF A01.

Every year each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In the part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems, and exhaust and evaporative emission control systems. The part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The part II application, submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 5485

5949 (BETC/P-B—8-1943-1) **Exhaust characterization of neat alcohol fueled IC engines. Final report.** Pullman, B.; Pefley, R.; Bechtold, R.; Allsup, J. (Santa Clara Univ., CA (USA); Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Research Center). Oct 1979. 30p. Dep. NTIS, PC A03/MF A01.

A late-model vehicle was converted to operate using methanol, gasoline, or ethanol as fuel and experimental work was done to obtain energy economy and exhaust emissions data for each of the three fuels. Results are compared at equal equivalence ratios both with and without an oxidation catalyst in the exhaust system. Using a catalyst for emissions control, unburned (hydro) carbon emissions were lowest during lean operating conditions and were nearly the same for all three fuels under those conditions. Oxides of nitrogen emissions typically were reduced by over 50% in changing from gasoline to methanol or ethanol. Detailed composition of the exhaust hydrocarbons was determined from analysis via gas chromatography. These data were used for calculating photochemical reactivities and comparisons were made among the fuels during cold start and FTP weighted tests. Gasoline exhaust was often calculated to have the lowest total reactivity during the FTP, however, methanol exhaust reactivity was lowest for the stoichiometric condition with catalyst. Aldehydes accounted for large fractions of the reactivity calculated for methanol and ethanol exhausts. Cold start emissions were of about equal reactivity for gasoline and methanol.

MATERIALS

REFER ALSO TO CITATION(S) 5236

5950 (DOE/US—0002-2) **Energy Materials Coordinating Committee (EMaCC) annual technical report, fiscal year 1979.** (Department of Energy, Washington, DC (USA)). Dec 1979. 201p. Dep. NTIS, PC A10/MF A01.

Materials research and development activities in environment, defense programs, nuclear energy, fossil energy, conservation and solar energy are briefly reported. (FS)

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 5259, 5888, 5978

5951 (CONF-791014—, pp III.91-III.96) **Characterizing and improving the toughness of thick-sectioned 2 1/4 Cr-1 Mo electroslag weldments.** Edwards, G.R.; Frost, R.H. (Colorado School of Mines, Golden). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5952 (CONF-791014—, pp III.97-III.99) **Welding research (1-485).** Key, J.F.; Smolik, G.R. (EG & G Idaho, Inc., Idaho Falls). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5953 (CONF-791014—, pp III.100-III.102) **Welding technology development (1A-007).** Smartt, H.B.; Turner, P.W. (EG & G Idaho, Inc., Idaho Falls). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5954 (DOE/ER/10367—1) **Manufacture of superconducting wire. Progress report, February 1-October 15, 1979.** Avitzur, B.; Chou, Y.T.; Talbert, S.; Wu, R. (Lehigh Univ., Bethlehem, PA (USA)). Oct 1979. Contract EM-78-S-02-4930. 70p. Dep. NTIS, PC A04/MF A01.

This report is divided into three major sections. The first section covers aspects of the manufacturing technology with existing and potential processes, and the second deals with the analysis of flow and fracture and the derivation of criteria to prevent failure. In the first section, typical present-day procedure to assemble a billet, extrude and draw it, with intermediate and final anneals, is described. Then an hypothetical production line with potential alternative processes along the entire path from heavy billet to fine wire, is laid out. Several processes at different stages of development, are offered. In the second section the analysis of core fracture and its prevention during the process of drawing is provided. Treatment of velocity fields for a bi-metallic rod leads to the determination of criteria for the prevention of fracture. The criteria are presented graphically. The third section describes work on micro properties of superconducting wires. A modification of the bronze method for niobium-tin superconductors is proposed and a preliminary schedule of the testing procedures is outlined.

5955 (PNL-SA—7888) **Development of graded composition Co-CrAlY (+ Pt) sputtered coatings.** Patten, J.W.; Moss, R.W.; Hays, D.D.; Fairbanks, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA); Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Utilization). 1979. Contract EY-76-C-06-1830. 14p. (CONF-790749—3). Dep. NTIS, PC A02/MF A01.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Progress is reported in the development of sputter deposited CoCrAlY-type coatings with Cr and Al concentration gradients through the coating thickness. The objective is to investigate the potential of high Cr coating surface compositions, gradients in Cr and Al composition, and Pt underlayers or graded Pt additions for significantly enhancing lifetimes of gas turbine engines operating on coal-derived liquid (and other alternative) fuels. Sputter coated burner rig test pins representing 15 different combinations of processing variables (including preoxidation heat treatment) sputter coated gas turbine first-stage blades with three different heat treatments, and several sputter coated fluidized bed turbine vanes are discussed along with testing status of these components.

5956 Effect of precipitation hardening on dynamic strain aging and jerky flow. Mulford, R.A. (Argonne National Lab., IL). *Metall. Trans., A;* **10**: No. 10, 1527-1532(Oct 1979).

Strain-rate sensitivity measurements were performed over a wide temperature range in commercial, precipitation hardened Ni and Al alloys. The results indicate that the dynamic strain-aging mechanism is not strongly affected by the presence of a precipitate dispersion. However, since precipitates influence the development of Luders type bands as well as the work hardening rate and other metallurgical variables, the critical strain for the onset of jerky flow is influenced. Therefore, the behavior of the critical strain cannot always be used to examine different theories for the origin of the negative strain-rate dependence of the flow stress which develops during straining and is a necessary (but not sufficient) condition for jerky flow.

5957 Austenitic stainless steel alloys having improved resistance to fast neutron-induced swelling. Bloom, E.E.; Stiegler, J.O.; Rowcliffe, A.F.; Leitnaker, J.M. (to Dept. of Energy). US Patent 4,158,606. 19 Jun 1979. Filed date 15 Mar 1978. 8p.

PAT-APPL-886,867.

The present invention is based on the discovery that radiation-induced voids which occur during fast neutron irradiation can be controlled by small but effective additions of titanium and silicon. The void-suppressing effect of these metals in combination is demonstrated and particularly apparent in austenitic stainless steels.

5958 Sintered rare earth-iron laves phase magnetostrictive alloy product and preparation thereof. Malekzadeh, M.; Pickus, M.R. (to Dept. of Energy). US Patent 4,152,178. 1 May 1979. Filed date 24 Jan 1978. 6p.

PAT-APPL-871,919.

A sintered rare earth-iron Laves phase magnetostrictive alloy product characterized by a grain oriented morphology is described. The grain oriented morphology is obtained by magnetically aligning powder particles of the magnetostrictive alloy prior to sintering. Specifically disclosed are grain oriented sintered compacts of Tb/sub x/Dy/sub 1-x/Fe_2 and their method of preparation. The present sintered products have enhanced magnetostrictive properties.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 5968, 5981, 5996, 5997

5959 (CONF-7909100—1) **Grain-boundary diffusion: structural effects, models and mechanisms.** Peterson, N.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 59p. Dep. NTIS, PC A04/MF A01.

From American Society of Metals seminar; Milwaukee, WI, USA (15 Sep 1979).

Grain boundary diffusion phenomena were considered including: anisotropy, effect of orientation, crystallographic transformation, boundary type, dislocation dissociation, pressure, and isotope effects. Diffusivity is different for various boundaries. Dissociated dislocations and stacking faults are not efficient paths for grain boundary diffusion. Results suggest a vacancy mechanism along the dislocation core, and involves atomic jumps away from the back towards the dislocation as well as jumps along the core. Measurements were made on nickel and silver. (FS)

5960 (COO—3084/70) **Energy variations in diffusive cavity growth.** Rice, J.R.; Chuang, T. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jun 1979. Contract EY-76-S-02-3084. 62p. Dep. NTIS, PC A04/MF A01.

The assignment of boundary values for the chemical potential and the calculation of energy release rates for the growth of creep cavities along grain boundaries by self-diffusion are discussed. It is assumed that the boundaries are flat and that surface and grain-boundary diffusion are the dominant transport mechanisms. As matter diffuses from the void surface into and along the grain boundary, misfit residual stresses are induced to alleviate the high stress concentration ahead of the cavity apex. As a result, it is shown that the contribution of strain energy terms to the chemical potential can be neglected in typical cases. Also, contrary to the Griffith crack extension model, the energy dissipation incurred by diffusive removal of material from the cavity surface and deposition in the grain boundary is a major term in the energy transfers associated with cavity growth. The primary energy sink in diffusive cavity growth arises from the work done by the grain-boundary normal stress when matter is inserted in the near-tip region by diffusion, and not from the loss of strain energy of matter that is removed from the cavity at its tip or from a work of bond separation. Thermodynamic restrictions on the angle formed by the void surfaces at their apex, where they join the grain boundary is described. The derivation of boundary values for the chemical potential is carried out in a manner appropriate for arbitrarily large but elastic distortions of material near the cavity tip and, by contrast to most previous work in the area. Rigorously the effects of surface tension, as distinct from surface energy, is included.

5961 (COO—3158-78) **Study of defects and radiation damage in solids by field-ion and atom-probe microscopy.** Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Jun 1979. Contract EY-76-S-02-3158. 31p. Dep. NTIS, PC A03/MF A01.

A brief review is presented of: the basic physical principles of the field-ion and atom-probe microscopes; the many applications of these instruments to the study of defects and radiation damage in solids; and the application of the atom-probe field-ion microscope to the study of the behavior of implanted ^{3}He and ^{4}He in tungsten.

5962 (LBL—9098) **Computer simulation of the formation of tweed and modulated structures in decomposition reactions.** Chen, S.; Morris, J.W. Jr.; Khachaturyan, A.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1979. Contract W-7405-ENG-48. 6p. (CONF-7903100—1). Dep. NTIS, PC A02/MF A01.

From American Crystallography Association meeting; Honolulu, HI, USA (26 Mar 1979).

A model of coarsening in a heterogeneous cubic alloy with cubic or tetragonal precipitates is proposed. According to the model the coarsening is controlled by the relaxation of the elastic strain energy. The computer simulation of coarsening demonstrates good agreement with electron microscopic observation of the structure and diffraction pattern.

5963 Multiphase diffusion in Fe-Ni-Al system at 1000°C. I. Diffusion structures and diffusion paths. Cheng, G.H. (China Steel Corp., Kaohsiung, Taiwan); Dayananda, M.A. *Metall. Trans., A;* **10**: No. 10, 1407-1414(Oct 1979).

Multiphase diffusion was investigated in the Fe-Ni-Al system at 1000°C with several series of solid-solid diffusion couples assem-

bled with selected β(bcc) and γ(fcc) alloys for the development of diffusion structures. The series of couples were characterized by a common β or γ terminal alloy joined to selected alloys of the other phase. The diffusion structures developed for the various couples exhibited interfaces of either planar, wavy, acicular, or flowery morphologies. Diffusion paths for the couples were determined by electron microprobe analysis. On the basis of isoconcentration contours in the vicinity of interfaces, the path-crossings of the (β + γ) two-phase region were found to be parallel to tie-lines for planar β/γ interfaces but were spread out into a band inclined to tie-lines for nonplanar interfaces. The band spread of path crossings for nonplanar β/γ interfaces showed compositional variations mainly on the γ-side of interfaces.

5964 Effect of oxygen on microstructures of high-rate sputter-deposited Nb_3Sn superconductors. Brimhall, J.L.; Wang, R. (Battelle Pacific Northwest Labs., Richland, WA). *Metall. Trans., A;* **10**: No. 10, 1499-1503(Oct 1979).

The role of excess oxygen and deposition temperature on the microstructure and critical temperature (T/sub c/) has been studied in high-rate, sputter deposited Nb_3Sn. Excess oxygen does not significantly affect the grain size of the A15 phase whether it is deposited at low temperature followed by annealing or deposited directly at an elevated temperature. Oxygen does promote the formation of the amorphous phase during deposition at low temperature. During subsequent transformation of material sputter deposited at room temperature, gas bubbles form from the entrapped sputtering gas. Excess oxygen also promotes greater precipitate formation during deposition at elevated temperature. In no case was there a large change in the superconducting transition temperature T/sub c/ ; however, the microstructural features may have significant effects on the critical current density J/sub c/.

5965 Control of ordered structure and ductility of (Fe, Co, Ni)$_3$V alloys. Liu, C.T.; Inouye, H. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **10**: No. 10, 1515-1525(Oct 1979).

This study is directed toward improvement of the ductility of long-range ordered alloys through control of their ordered crystal structure. A series of ordered alloys was prepared with a base composition of Co_3V, where Co was partially replaced with Fe and Ni. The stability and structure of the ordered phases in these $(Fe,Co,Ni)_3V$ alloys were characterized by various metallurgical methods. The results indicate that the ordered structure in this alloy system can be controlled by adjusting the electron density, and that the $L1_2$ type cubic ordered structure (α') is stable in the alloys with electron density less than 7.888. The phase relation in the cubic ordered alloys depends on the Fe concentration. For the alloys containing < 20 pct Fe, the disordered α solid solution transforms to the cubic α' ordered on the fcc lattice at temperatures below 1000°C. For the alloys containing > 20 pct Fe, the α' is formed through a peritectoid reaction, namely, $\alpha + \sigma \rightarrow \alpha'$. Tensile tests indicate that the alloys with multilayered hexagonal ordered structure are very brittle, while the alloys with the cubic ordered structure are ductile at room temperature. The ductility of the cubic ordered alloys increases with decreasing Co content. The alloys with < 55 pct Co showed dimple type ductile rupture with elongation over 40 pct at room temperature. The correlation of ductility with ordered structure is discussed.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 5226, 5244, 5254, 5255, 5256, 5257, 5260, 5261, 5262, 5264, 5279, 5297, 5328, 5676, 5680, 5743, 5954, 5960, 5965, 5989, 5992, 6080

5966 (ANL—79-63) **Mechanical properties test program on structural materials in a sodium environment.** Natesan, K.; Chopra, O.K.; Kassner, T.F. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 20p. Dep. NTIS, PC A02/MF A01.

This document describes in detail the ongoing and planned US Test program on the mechanical properties of sodium-exposed Type 316 austenitic stainless and Fe-2 1/4 Cr-1 Mo ferritic steels. The test program is based on the Development Requirement Specifications (DRS) established by the DOE/Clinch River Breeder Reactor Project (CRBRP) Program Office, the general need for the development of LMFBR structural-design criteria established by the Nuclear Systems Materials Handbook, and the need for a fundamental understanding of materials behavior in a sodium environment, which is generic to LMFBR systems. The planned test program is an extension of work based on current knowledge of sodium chemistry and the influence of sodium purity on the mechanical properties of structural materials.

5967 (BMX—579) **Effect of thermal cycling and hydrogen absorption on selected properties of 55-Nitinol.** Beuhring, V.F.; Jackson, C.M.; Wagner, H.J. (Battelle Columbus Labs., OH (USA)). 15 Sep 1969. Contract W-7405-ENG-92. 84p. Dep. NTIS, PC A05/MF A01.

The unique ability of the alloy 55-Nitinol to be restored to a predetermined shape by moderate heating, and to exert considerable force during the shape-restoration, makes it attractive for certain mechanical systems. An important requisite to its utilization was a knowledge of how the alloy would be affected by a H environment and by thermal cycling in this temperature range encountered under ambient conditions. After 500 thermal cycles from -100 to +165°F, 55-Nitinol displayed the same ability to be restored to its memory shape as it had before cycling. Similarly, the force exerted when the alloy was completely restrained while it was heated beyond its shape-recovery temperature was not changed by thermal cycling. When the upper limit of the thermal cycling was 200°F, which is above the temperature at which shape recovery can occur, both the shape change characteristics and the force characteristics were changed. H introduced to a level of 100 ppM, did not change the shape-recovery behavior or force behavior.

5968 (COO—2172-29) **Mechanical properties of crystalline solids. Progress report, December 1, 1978-November 30, 1979.** Li, C.; Hart, E.W. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). 1 Sep 1979. Contract EY-76-S-02-2172. 60p. Dep. NTIS, PC A04/MF A01.

The work performed during the past fiscal year included: the development and preliminary experimental verification of a second generation deformation model based on state variables, which more correctly represents transient deformation; the establishment of experimental capabilities for investigating grain boundary anelasticity and the development of unified phenomenological models for grain boundary anelasticity and grain boundary sliding; the continued investigation of grain boundary cavitation processes in the Zircaloys; and the theoretical modeling of stress relaxation in thin films.

5969 (COO—2422-20) **K/sub ID/ values deduced from shear force measurements on DCB specimens.** Chow, C.L.; Burns, S.J. (Rochester Univ., NY (USA)). 1978. Contract EY-76-S-02-2422. 24p. (CONF-7811148—2). Dep. NTIS, PC A01/MF A01.

From ASTM conference on crack arrest Methodology and Applications; Philadelphia, PA, USA (Nov 1978).

Time varying shear force measuring techniques have been used to investigate the dynamic critical stress intensity factor versus crack propagation velocity curve. The product of the shear force at the loading end times the square root of the loading time on a rapidly wedged DCB specimen is uniquely related to the critical bending moment at the crack tip. Static compliance measurements on side grooved specimens were incorporated into a Bernoulli-Euler beam model for calibration purposes and to eliminate the inappropriate built-in beam assumption. The compliance calibration shows a crack length shift from a measured crack length to a beam model length at a fixed compliance value. This shift does not effect the magnitude of the calculated critical bending moment at the crack tip when the load and the load point displacement are measured quantities. The effective crack length is calculated from the beam model length with the length shift correction. The K/sub ID/ values (calculated from the critical bending moment) versus crack velocity have been investigated at several test temperatures for a low carbon steel. K/sub ID/ values show a generally decreasing trend when crack velocity increases. K/sub IC/ at fast fracture initiation, is larger than the corresponding K/sub ID/ value for all tests recorded.

5970 (COO—2422-21) **Fast fracture: an adiabatic restriction on thermally activated crack propagation.** Burns, S.J. (Rochester Univ., NY (USA). Dept. of Mechanical and Aerospace Sciences). 1978. Contract EY-76-S-02-2422. 15p. (CONF-7811148—1). Dep. NTIS, PC A01/MF A01.

From ASTM conference on crack arrest Methodology and Applications; Philadelphia, PA, USA (Nov 1978).

Slow, isothermal, crack propagation is widely suspected to be rate controlled by thermally activated plastic deformation in the crack tip region. Adiabatic conditions are generally established in the fracture modified material at the tip of a crack during fast fracture. The temperature of this material is not the temperature of the specimen and is generally not measured during fast fracture. Thus, a complete thermodynamic description of adiabatic crack propagation data can not be made. When the slow, isothermal, crack propagation mechanisms are assumed to be operative during adiabatic crack propagation then certain predictions can be made. For example: the changes in the driving force due to temperature and rate are always in the opposite sense; there is no minimum in the driving force versus crack velocity without a change in mechanism; the temperature rise in the crack tip fracture modified material is determined mainly by the activation enthalpy for crack propagation; the interpretation of fast fracture structural steel data from simple plastic models is suspect since these materials have dissimilar isothermal temperature dependencies.

5971 (COO—2422-22) **Materials and mechanics of rate effects in brittle fracture. Progress report, October 1978-October 1979.**

Burns, S.J. (Rochester Univ., NY (USA)). Oct 1979. Contract EY-76-S-02-2422. 19p. Dep. NTIS, PC A02/MF A01.

A thermodynamic formulation for a crack driving force has been experimentally used in linear elastic fracture mechanics, elastic plastic fracture mechanics and creep fracture. In linear elastic and elastic plastic fracture mechanics, mechanical stability criteria are established from the load versus the load point displacement in two test specimens that differ only in crack area. These tests have also been used to measure the fracture toughness in several heat treated steels. Creep cracking of PMMA has shown that there is a sharp transition to unstable fracture in a plot of the log of the steady state crack velocity versus the crack driving force at several selected temperatures. In addition, it has been shown that the athermal crack driving force is independent of rate and temperature. A new method for electronically recording the crack driving force versus the crack area has been used on double cantilevered beam specimens. Temperature and crack rate dependences have been measured near the ductile to brittle transition temperature in a low carbon steel.

5972 (COO—10359-1) **Environmental reactions and their effects on mechanical behavior of metallic materials. Technical progress report, February 1, 1979-January 31, 1980.** Gibala, R.; Fournier, R.; DeMiglio, D.; Ratka, J. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Metallurgy and Materials Science). 31 Oct 1979. Contract EY-76-S-02-1676. 25p. Dep. NTIS, PC A02/MF A01.

The results of research are presented. Completed results have been obtained in each of three experimental project areas: mechanical behavior of Nb-H and Nb-D alloys; implantation softening of niobium; and the crack path in hydrogen embrittlement of 4340 steel. Results show hydrogen or deuterium softening in niobium is related to the ability of hydrides and deuterides to punch out glissile dislocations; implanted surface layers of oxygen ions in niobium reduce the flow stress at low temperatures; and the hydrogen-assisted crack path in 4340 steel can be identified at electron microscopy resolutions as intergranular, interlath or translath, depending upon the strength level.

5973 (GA-A—15558) **Effect of aging and cold working on the high-temperature low-cycle fatigue behavior of alloy 800H: Part II continuous cyclic loading.** Villagrana, R.E.; Kaae, J.L.; Ellis, J.R. (General Atomic Co., San Diego, CA (USA); Oak Ridge National Lab., TN (USA)). Oct 1979. Contract AT03-76ET35300. 36p. Dep. NTIS, PC A03/MF A01.

The individual and combined effects of cold working (5 and 10 pct) and aging (4000 and 8000 h in the temperature range 538 to 760°C) on the high-temperature low-cycle fatigue behavior of alloy 800H have been investigated. The specimens were tested at the aging temperatures. Both the saturation stress range and the fatigue life were found to be history dependent. A history-independent hardening mechanism, dynamic strain aging, was found to operate over the temperature range ~ 450 to 650°C and to be maximized at ~ 550°C. It is speculated that carbon is responsible for this dynamic strain aging. Finally, at temperatures above 538°C the Coffin-Manson plots indicate the possible existence of a history-independent softening mechanism.

5974 (ORNL/TM—6998) **Elevated-temperature deformation and failure test of a type 304 stainless steel capped cylindrical shell: specimen CC-2.** Clinard, J.A.; Richardson, M.; Battiste, R.L.; Sartory, W.K. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 57p. AT.

Results are presented from a high-temperature deformation and failure test of a type 304 stainless steel capped cylindrical shell, specimen CC-2. The specimen was subjected to time-varying pressure and temperature which produced elastic-plastic-creep response. The test was terminated when failure occurred by opening of a creep crack which propagated circumferentially in the junction region between the cap and the cylinder. The test, which was performed to provide for assessment of the accuracy and validity of structural analysis methods and related computer programs, was conducted as part of the ORNL High-Temperature Structural Design (HTSD) Program effort related to development and verification of a design methodology applicable to liquid-metal fast breeder reactor (LMFBR) system components. The specimen was fabricated using a well-characterized heat (heat 9T2796) of type 304 stainless steel. Capacitive-type strain gages provided reliable strain-time response over the specimen life of 3300 hr. Complete test results are provided on microfiches. Analysis activities are discussed and computed results are compared to measured specimen response. Inelastic analysis predictions of the deformation phase were in reasonable agreement with strain-gage data. Failure predictions, based on both elastic and inelastic calculations, were conservative, although the degree of conservatism of inelastic failure predictions for this test could not be exactly determined since computational difficulties prevented complete solution of the large-deformation failure phase.

5975 (ORNL/TM—6999) **Fatigue crack propagation in Hastelloy X weld metal.** Weerasooriya, T. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

The fatigue crack growth rate of Hastelloy X weld metal increased with stress intensity, temperature, and inverse frequency. The results were correlated with the equation da/dN = (ΔK)/sup n/, for constant frequency or constant temperature. The values of A and n were computed with a linear regression algorithm. With decreasing frequency at constant ΔK and constant temperature (538°C) fatigue crack growth rates approach an upper limit. Fatigue crack growth rate of the weld metal was lower than that reported for base metal at 538°C and lower at 649°C for a frequency of 1 Hz.

5976 **Short-range order effects on the tensile behavior of a nickel-base alloy.** Klueh, R.L.; King, J.F. (Oak Ridge National Lab., TN). *Metall. Trans., A;* **10**: No. 10, 1543-1548(Oct 1979).

A nickel base weld filler metal alloy with nominal composition of 67 pct Ni, 20 pct Cr, 3 pct Mn, 3 pct Fe, and 2.5 pct Nb (Cb) is used to make austenitic-ferritic dissimilar metal joints. Tensile properties were determined for this alloy over the range 25 to 732°C at strain-rates of 3 x 10^{-6} and 3 x 10^{-4}/s. Above about 450°C, both the yield strength and the ultimate tensile strength in the low strain-rate tests showed significant increases over the strengths at the higher strain-rate. The enhanced values for the yield strength persisted to the highest test temperature (732°C), whereas the ultimate tensile strength for the low strain-rate fell below the curve for the higher strain-rate at about 600°C. Above 600°C, the ultimate tensile strength dropped off rapidly and at 677°C approached the yield strength (i.e., the uniform elongation dropped to less than 1 pct). The strain-rate effects have been attributed to K-state formation, an effect that investigators have attributed to short range order in other Ni-Cr base alloys.

5977 **Critical fracture stress and fracture strain models for the prediction of lower and upper shelf toughness in nuclear pressure vessel steels.** Ritchie, R.O.; Server, W.L.; Wullaert, R.A. (Massachusetts Inst. of Tech., Cambridge). *Metall. Trans., A;* **10**: No. 10, 1557-1570(Oct 1979).

Critical fracture stress and stress modified fracture strain models are utilized to describe the variation of lower and upper shelf fracture toughness with temperature and strain rate for two alloy steels used in the manufacture of nuclear pressure vessels, namely SA533B-1 (HSST Plate 02) and SA302B (Surveillance correlation heat). Both steels have been well characterized with regard to static and dynamic fracture toughness over a wide range of temperatures (-190 to 200°C), although valid J/sub Ic/ measurements at upper shelf temperatures are still somewhat scarce. The present work utilizes simple models for the relevant fracture micromechanisms and local failure criteria to predict these variations in toughness from uniaxial tensile properties. Procedures are discussed for modelling the influence of neutron fluence on toughness in irradiated steel, and predictions are derived for the effect of increasing fluence on the variation of lower shelf fracture toughness with temperature in SA533B-1.

5978 (RDT-M—1-2OT(8-79)(Rev.)) **Mild steel electrodes for flux-cored arc welding (ASME SFA-5.20 with additional requirements.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Aug 1979. Contract W-7405-ENG-26. 9p. RSO.

This standard covers mild steel electrodes for gas metal-arc welding for nuclear and associated applications. Material shall conform to the requirements of ASME SFA-5.20; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 5263, 5888, 5958, 5963, 6327

5979 (CONF-791134—1) **Transport properties of concentrated Ag-Pd and Cu-Ni alloys from 300-1000 K.** Yarbrough, D.W.; Williams, R.K.; Graves, R.S. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From 16. international thermal conductivity conference; Chicago, IL, USA (7 Nov 1979).

Thermal conductivity data for concentrated binary Ag-Pd and Cu-Ni alloys at temperature above 300°K were determined. The equipment used is described. (FS)

5980 (UCRL—82797) **Black chrome outgassing study.** Beat, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

This report covers why black chrome is of interest, why its outgassing is relevant, how the study was conducted, examples of resultant data, and a conclusion. Black chrome is of interest in several areas of activity. Vacuum outgassing characteristics must be known to establish the pumping speed requirements. How much gas is evolved determines the pump speed required. The species of gas

evolved determines the type of pump. The outgassing characteristics must be known to determine needed precleaning steps.

5981 Multiphase diffusion in Fe-Ni-Al system at 1000°C. II. Interdiffusion coefficients for β and γ alloys. Cheng, G.H. (China Steel Corp., Kaohsiung, Taiwan); Dayananda, M.A. *Metall. Trans., A;* **10A**: No. 10, 1415-1419(Oct 1979).

Ternary interdiffusion coefficients were determined at 1000°C at several Fe-Ni-Al alloy compositions with multiphase β(bcc) vs γ(fcc) diffusion couples which developed planar β/γ-interfaces. The coefficients, D tilde/sub ij//sup Fe/ (i,j = Al or Ni) were calculated at compositions corresponding to points of intersections of diffusion paths with Fe taken as the dependent component. These coefficients varied with composition by 1 to 2 orders of magnitude in the β-phase but relatively little in the γ-phase. Empirical relations were derived to describe the composition dependence of the main coefficients. D tilde/sub AlAl//sup Fe/ and D tilde/sub NiNi//sup Fe/. Interdiffusion coefficients with either Al or Ni as the dependent component were also evaluated. The relative diffusivities of the elements increase in the order, Fe, Ni, Al for both β- and γ-alloys. The ternary diffusion data were consistent with binary interdiffusion coefficients for Fe-Al and Fe-Ni alloys.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 5226, 5227, 5237, 5242, 5243, 5244, 5245, 5246, 5247, 5248, 5249, 5250, 5251, 5252, 5253, 5254, 5255, 5260, 5262, 5263, 5264, 5265, 5280, 5295, 5296, 5298, 5299, 5300, 5301, 5311, 5334, 5470, 5676, 5679, 5680, 5681, 5682, 5879, 5888, 5889, 5955, 6093, 6109, 6110, 6111

5982 (CONF-791014—, pp K.146-K.187) **Thermodynamics of high temperature corrosion.** Meier, G.H. (Univ. of Pittsburgh, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

The basic types of thermodynamic diagrams useful in interpreting the results of high temperature corrosion experiments have been discussed. While no attempt at a complete discussion of this subject has been made, it is hoped this article will facilitate a better understanding of the use of such diagrams and stimulate increased effort in experimental and theoretical work to expand their use and improve their accuracy.

5983 (INKA-Conf—79-214-000) **Corrosion and corrosion prevention in buried pipelines and containers.** (Deutscher Verein des Gas- und Wasserfaches e.V. (DVGW), Eschborn (Germany, F.R.)). 1979. 21p. (In German). (CONF-7905122—(Absts.)). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Corrosion and corrosion prevention in barried pipelines and containers conference; Sprendlingen, F.R. Germany (30 May 1979).

Summaries are presented of papers on the underground corrosion behavior of metals and methods for prevention of corrosion in buried pipes and containers. The summaries included are: corrosion behavior of metallic materials; corrosion behavior of copper and copper alloys; corrosion damage in buried steel and cast iron pipes; passive corrosion prevention in pipelines and containers; problems in cathodic protection of pipelines; cathodic protection of borehole tubing, tank forms, and containers; local cathodic protection in industrial and power plants; potential measurement in cathodic protection; interaction between pipe cladding and cathodic corrosion protection; and control, safety, and economic aspects of cathodic protection. (HDR)

5984 (ORNL/TM—7011) **Cladding of 2 1/4 Cr-1 Mo steel with type 320Cb stainless steel.** Edmonds, D.P.; Goodwin, G.M. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 42p. Dep. NTIS, PC A03/MF A01.

Techniques have been developed for weld overlay cladding of 2 1/4 Cr-1 Mo steel base metal with type 320Cb stainless steel. With conventional type 320Cb filler wires, fissure-free single-layer submerged-arc (SA) cladding can be applied by using nickel-fortified fluxes. Two-layer techniques, with an intermediate nickel layer, are required for gas metal-arc (GMA) cladding with these materials. Fissuring was a function of the nickel concentration in the deposits. The SA cladding tolerated lower nickel contents in the deposit without fissuring than the GMA cladding. About 40 wt % Ni is required to prevent fissuring in the GMA cladding, while only about 30 wt % is required for the SA cladding. Also, microprobe analyses showed tha niobium is involved in fissuring in these deposits. No cracking was observed beneath the cladding with any of the 2 1/4 Cr-1 Mo steel base metals used in this study.

5985 (RFP—3018) **Corrosion of delta plutonium by water.** Hodges, A.E. III; Haschke, J.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 9p. (CONF-791079—1). Dep. NTIS, PC A02/MF A01.

From 7. DOE compatibility meeting; Aiken, SC, USA (16 Oct 1979).

Corrosion of delta-stabilized (1 wt % Ga) WR plutonium was studied in water, synthetic sea water, tap water, and distilled water. The product is a dark blue-green residue, suggesting a mixture of hydrated trivalent and tetravalent plutonium hydroxides. The corrosion rate, inversely dependent on pH, increases with ionic concentration and decreases with thicker surface layer of the product hydroxide. The competing spallation of the product layer is discussed. 3 figures. (DLC)

5986 Effect of strain rate on stress corrosion cracking in duplex Type 304 stainless steel weld metal. Baeslack, W.A. III; Savage, W.F.; Duquette, D.J. (Air Force Materials Lab., Wright Patterson AFB, OH). *Metall. Trans., A;* **10**: No. 10, 1429-1435(Oct 1979).

The influence of strain-rate on the stress-corrosion cracking properties of wholly austenitic Type 304 base metal and duplex austeno-ferritic Type 304 weld metal in boiling $MgCl_2$ was investigated using constant extension rate tensile testing techniques. Transgranular SCC in both base and weld metals is preferred at low strain-rates, while intergranular cracking in the base metal and interphase cracking along the austenite-ferrite interface in the weld metal are preferred at higher strain-rates. Promotion of the intergranular stress-corrosion cracking in the base metal and interphase-interface stress-corrosion cracking in the weld metal with increases in strain-rate may be mechanistically analogous. Stress-induced alterations in the grain or interphase boundary defect structure may make these regions preferentiallv susceptible to dissolution.

5987 Method for inhibiting corrosion in aqueous systems. De-Monbrun, J.R.; Schmitt, C.R.; Schreyer, J.M. (to Dept. of Energy). US Patent Application 960,982. 15 Nov 1978. 9p.

A method for inhibiting corrosion in aqueous systems containing components composed of aluminum, copper, iron, or alloys is described. The method consists of incorporating in the aqueous medium 2 to 10 ppM by weight of tolytriazole; an effective amount of a biodegradable organic biocide; 500 to 1000 ppM by weight of sodium metasilicate; 500 to 2000 ppM by weight of sodium nitrite; and 500 to 2000 ppM by weight of sodium tetraborate. All of these concentrations are based on the weight of water in the system and maintain the pH of the resulting system in the range of 7.5 to 8.0. The method permits longterm operation with very low corrosion rates and bacteria counts. All of the additives to the system are biodegradable, permitting the treated aqueous medium to be discharged to the environment without violating current regulations. The method has application to solar systems in which an aqueous medium is circulated through aluminum-alloy heat exchangers.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 5753, 5957

5988 (COO—3158-79) **Direct determination of radiation damage profiles in the order-disorder alloy Pt_3Co irradiated with low-energy (500-2500 eV) Ne^+ ions.** Aidelberg, J.; Seidman, D.N. (Cornell Univ., Ithaca, NY (USA). Materials Science Center). Jul 1979. Contract EY-76-S-02-3158. 13p. (CONF-790843—12). Dep. NTIS, PC A02/MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

A new approach was developed, employing the field-ion microscope technique, to determine directly radiation damage profiles in order-disorder alloys; the approach was applied to Pt_3Co. The experiment consisted of irradiating in situ, at 30°K, Pt_3Co specimens with low-energy (500 to 2500 eV) Ne^+ ions. The specimens were subsequently dissected on an atom-by-atom basis employing the pulse field-evaporation technique. The latter procedure made it possible to determine the change in the Bragg-Williams long-range order parameter (S) as a function of distance from the irradiated surface. The measurement of $\Delta S/sub\ d/$, where the subscript indicates damage, versus distance (x) constituted a radiation damage profile; the depth resolution of this profile was aproximately equal to 2 A. The mean depth of damage (anti $x/sub\ d/$) varied from approximately equal to 9 to 20 A and the standard deviation or straggling (Δx) varied from approximately equal to 6 to 18 A as the implantation energy was increased from 500 to 2500 eV. The radiation damage profiles have also been used to determine the effective stopping power of Ne in Pt_3Co.

5989 Comparison of the in-reactor creep of selected ferritic, solid solution strengthened, and precipitation hardened commercial alloys. Paxton, M.M.; Chin, B.A.; Gilbert, E.R.; Nygren, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). *J. Nucl. Mater.;* **80**: No. 1, 144-151(Mar 1979).

The results of an in-reactor creep experiment designed to compare the creep behavior of nine commercial alloy compositions and one modified composition in various heat treatments are presented. Data are reported for one temperature, 540°C, after accumulated

nominal fluences of 2 and $4x10^{22}$ n/cm^2 (E>0.1 MeV). Selected ferritic, solid solution strengthened and precipitation hardened alloys of the Fe-Cr-Ni system were investigated. In general, the high strength precipitation hardened alloys have the greatest resistance to in-reactor creep. Thermomechanical heat treatments are shown to influence the creep behavior. The results when compared with a semi-empirical creep equation, suggest a possible interrrelation between irradiation creep and swelling.

5990 (HEDL-SA—1784) **Strength and ductility of austenitic stainless steels irradiated in various fast reactor spectra.** Blackburn, L.D.; Ward, A.L.; Simons, R.L.; Lippincott, E.P. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 8p. (CONF-791051—14). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

Radiation damage cross sections derived from mechanical property changes in stainless steels 304, 316, and 308L decrease as the fast reactor spectrum softens from a mean neutron energy of 0.75 MeV to 0.2 MeV. Spectral sensitivity of 304 is greater than that of 316 and 308L weld deposits. Damage cross sections are generally consistent with existing empirical or theoretical damage models but do not verify the applicability of any one particular theoretical model. (FS)

5991 (LBL—9901) **Defects in germanium: new results and novel methods.** Haller, E.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 31p. (CONF-790995—1). Dep. NTIS, PC A03/MF A01.

From International conference on radiation physics in semiconductors and related materials; Tbilisi, USSR (13 Sep 1979).

Recent results obtained from quenching experiments, electron, gamma-ray, neutron and proton irradiation of germanium are reviewed. Major emphasis is given to the introduction of novel techniques for the study of shallow and deep levels. Explicitly introduced are Photothermal Ionization Spectroscopy (also called Photoelectric Spectroscopy), Deep level Transient Spectroscopy and High-Q Electron Paramagnetic Resonance. Using as examples the recently discovered hydrogen-related centers and the lithium/lithium-oxygen system in germanium it is shown that a combination of techniques can yield information on composition and structure of defects.

5992 (NUREG/CR—1070) **Evaluation of the unloading compliance procedure for J integral testing in the hot cell. Final report.** Clarke, G.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 1979. Contract W-7405-ENG-26. 64p. (ORNL/Sub—7394-1). Dep. NTIS, PC A04/MF A01.

A testing program was initiated to develop a procedure for toughness testing of irradiated materials using J integral methods. An evaluation of presently used procedures and improved techniques was completed to increase the reliability of the unloading compliance method for single specimen J/sub Ic/ determination. Three different heats of pressure vessel steels were used to evaluate the reliability and accuracy of the unloading compliance procedure. A new technique for improved sensitivity of displacement measurements was found to be successful on large 4T specimens. This technique consisted of using a small electrical linear actuator to continuously rezero a 0.635 mm (.025 inch) LVDT. The effects of specimen geometry on both J/sub Ic/ and dJ/da were evaluated using various specimen sizes and varying amounts of side grooving.

5993 (UWFDM—286) **Swelling-induced stresses in ion-bombarded surfaces: effect of crystalline orientation.** Wolfer, W.G.; Garner, F.A. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering; Westinghouse Hanford Co., Richland, WA (USA)). Jan 1979. Contract ER-78-S-02-4861. 7p. (CONF-790125—83). Dep. NTIS, MF A01.

From 1. topical meeting on fusion reactor materials; Miami Beach, FL, USA (29 Jan 1979).

Portions of document are illegible.

The state of stress in ion-bombarded specimens is analyzed. The magnitude of the lateral compressive stresses is shown to depend on the ratio of the swelling rate to the creep rate compliance. The latter is given for three different mechanisms of irradiation creep in face-centered cubic crystals. Due to the dependence of the creep compliance on the crystal orientation, the lateral stresses in a given grain depend on its orientation with respect to the specimen surface. Detailed results are presented of the state of stress as a function of the grain orientation for all three irradiation creep mechanisms. These results are discussed in the context of blistering and step-height measurements.

5994 **Radiation-induced outgassing from Type 304 stainless steel.** Toepker, T.P. (Xavier Univ., Cincinnati, OH); Anno, J.N. *Nucl. Technol.;* **46**: No. 1, 127-133(Nov 1979).

A Type 304 stainless-steel vacuum system has been designed and constructed to study radiation-induced outgassing when this material is exposed to ^{60}Co gamma radiation. An analytical model has been developed that predicts the outgassing from Type 304 stainless steel to be 5 x 10^{-10} Pa.l/cm^2.s per Mrad/h. Experiments determined the value for Type 304 stainless steel after bakeout at 300°C to be (1.03 +- 0.58) x 10^{-9} Pa.l/cm^2.s per Mrad/h, in fair agreement with the analytical model predictions. Studies on thermally induced outgassing from Type 304 stainless steel showed that after bakeout at temperature T/sup */, thermal outgassing Δ obeys the relationship Δ = $Δ_0$ exp(-anti Q/RT), where both the constant $Δ_0$ and the average desorption energy anti Q are functions of T/sup */. Water vapor and hydrogen were the principal residual gases in a Type 304 stainless-steel vacuum system, with hydrogen being dominant at low pressures after bakeout.

5995 **Dose dependence of radiation-induced segregation in Ni-1 at% Si.** Rehn, L.E.; Okamoto, P.R.; Wiedersich, H. (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* **80**: No. 1, 172-179(Mar 1979).

Measurements have been made of alloy composition as a function of depth from the external surface in Ni-1 at% Si specimens after irradiation with 3-MeV $^{58}Ni^+$ ions to several different doses at nominal temperatures of 525 and 600°C. Very rapid segregation of Si toward the external surface ocurred during irradiation. Surface concentrations of Si in excess of the 10 at% solubility limit were found at both irradiation temperatures after a dose of only approximately 0.05 dpa. The rate of segregation decreased markedly in the dose range from approximately 1-10 dpa. Qualitative agreement was found between the experimental observations and calculations made using a modified Johnson-Lam segregation mode (1976). The present investigation suggests that radiation-induced segregation may significantly alter the mechanical behavior of irradiated alloys long before the onset of void swelling.

5996 **Ferrite formation in neutron-irradiated Type 304L stainless steel.** Porter, D.L. (Argonne National Lab., Idaho Falls, ID (USA)). *J. Nucl. Mater.;* **79**: No. 2, 406-411(Feb 1979).

Austenitic (γ) to ferrite (α) transformation was observed using transmission electron microscopy in Type 304L stainless steel that had been irradiated at approximately 500°C to fast-neutron (E > 0.1 MeV) fluences greater than approximately 3 X 10^{22} n/cm^2. Previous studies on similar unirradiated stainless steels found no such transformation, indicating that the $\gamma \rightarrow \alpha$ transformation was irradiation-induced. The α phase appeared to nucleate on stacking faults, indicating that the presence of large Frank loops was the critical step in the transformation. After an entire grain of austenite had transformed, the only remaining γ phase existed as shells around voids. Coincidence of rapid swelling behaviour with $\gamma \rightarrow \alpha$ transformation indicated that the two were related, perhaps by reaction of both phenomena to the effects of irradiation and temperature on microchemical segregation. A volume expansion of about 2.5% was found to be associated with the transformation. Inferences are drawn relating this behavior in Type 304L steel to the effects of radiation on other reactor structural materials such as Type 316 stainless steel, which is also a metastable austenitic composition.

5997 (PNL-TR—372) **Crystallization and irradiation effects in an amorphous alloy of the type $Fe_{40}Ni_{38}Mo_4B_{18}$.** Azam, N.; Le Naour, L.; Rivera, C.; Grosjean, P.; Sacovy, P.; Delaplace, J. Translated from *J. Nucl. Mater.;* **83**: 298-304(1979). 16p. Dep. NTIS, PC A02/MF A01.

The structure of an amorphous alloy of the composition $Fe_{40}Ni_{38}Mo_4B_{18}$ either in the untreated fabricated state, or after various thermal treatments, or after irradiation with heavy ions was studied. The amorphous state is not modified by heat treatments at temperatures below 300°C. After several hours at 350°C, crystallization begins by forming crystals of an FeNi-base solid solution. The crystallization is complete after a two-hour treatment at 500°C. This alloy, bombarded with 500-keV Ni^+ ions, proved to be practically insensitive to irradiation at the ambient temperature at high doses (6 x 10^{16} ions/cm^2, i.e., approximately 100 dpa). A 100 to 150°C lowering of the crystallization temperature was observed under irradiation.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 5267, 5268, 5270, 5278, 5673, 5686, 5687, 5882, 5885, 5886

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 5298, 5418, 5419, 5420, 5685, 5731

5998 (CONF-791014—, pp IV.42-IV.43) **Sialon refractories from clay and coal.** Cutler, I.B. (Univ. of Utah, Salt Lake City). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

5999 (CONF-791014—, pp VI.37) **Plasma-deposited thermal barrier coatings.** Tucker, R.C. Jr.; Price, M.O.; Taylor, T.A. (Union Carbide Corp., Indianapolis, IN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6000 (COO—2408-6) **Pressure sintering and creep deformation: a joint modeling approach.** Notis, M.R. (Lehigh Univ., Bethlehem, PA (USA)). Oct 1979. Contract EY-76-S-02-2408. 22p. Dep. NTIS, PC A02/MF A01.

Work related to microchemical and microstructural aspects of the joint modeling of pressure sintering and creep in ceramic oxides is reported. Quantitative techniques for the microchemical analysis of ceramic oxides and for the examination of impurity segregation effects in polycrystalline ceramic materials were developed. This has included fundamental absorption corrections for the oxygen anion species as a function of foil thickness. The evolution in microstructure during the transition from intermediate stage to final stage densification during hot pressing of cobalt oxide and preliminary studies with doped oxides were studied. This work shows promise in using time-integrated microstructural effects to elucidate the role of impurities in the sintering of ceramic materials.

6001 (PNL-SA—7809) **Improvement of sputtered oxide coating adherence and integrity for turbine airfoil applications.** Bayne, M.A.; Busch, R.; Fairbanks, J.W.; Patten, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA); Department of Energy, Washington, DC (USA). Div. of Fossil Fuel Utilization). 1979. Contract EY-76-C-06-1830. 28p. (CONF-790749—2). Dep. NTIS, PC A03/MF A01.

From Conference on advanced materials for alternate fuel capable directly fired heat engines; Castine, ME, USA (30 Jul 1979).

Two aspects of the durability of modified ZrO_2 ceramic thermal barrier coatings for gas turbine airfoils are being investigated. First, adherence of coatings of these materials has historically been difficult to achieve due to mismatch in thermal expansion coefficients and other properties between ceramic coatings and metallic substrates. Second, if the ceramic coatings are discontinuous, as for many plasma sprayed coatings, then condensate from the combustion environment may permeate the coating and volume changes in this condensate during subsequent service cycles may produce coating spallation. The adherence problem is approached in this work by seeking to sputter deposit ceramic coatings over either sputter-etched, closely spaced, high aspect ratio substrate surface cones or by sputter depositing ceramic coatings over sputtered CoCrAlY coatings containing a very high density of columnar voids (leaders). The objective in both instances is to provide a compliant fibrous metal attachment between metal substrate and ceramic coating to absorb property mismatches. Progress in providing the fibrous layers and preliminary evaluation of adherence are discussed. The permeability problem is approached both by providing a continuous and impervious ceramic overlayer, and by coating the ceramic layer with a continuous and impervious metal sealing layer that is not required to provide structural strength or insulation. The merits of both of these approaches and preliminary experimental results are discussed.

6002 **Synthesis of fine particle size lithium aluminate for application in molten carbonate fuel cells.** Kinoshita, K.; Sim, J.W.; Kucera, G.H. (Argonne National Lab., IL). *Mater. Res. Bull.;* **14**: No. 10, 1357-1368(Oct 1979).

Lithium aluminate ($LiAlO_2$) was synthesized by heat treatment of various types of aluminas (γ-Al_2O_3, α-Al_2O_3, γ-AlOOH, and $Al(OH)_3$), Li_2CO_3 or LiOH, and Li_2CO_3-K_2CO_3. For this procedure, the temperature (625 to 975°K) and time (1.5 to 90 h) of heat treatment were varied to determine the optimum conditions to obtain γ-$LiAlIO_2$ of high surface area, which was suitable for electrolyte structures in molten carbonate fuel cells. A mixture of Li_2CO_3-K_2CO_3 and high surface area γ-$LiAlO_2$ was obtained by the heat treatment of γ-Al_2O_3, LiOH, and Li_2CO_3-K_2CO_3 at 775 K for 2 h, then at 975 K for 16 h. However, when γ-AlOOH, $Al(OH)_3$, and α-AL_2O_3 were substituted for γ-Al_2O_3 in the synthesis procedure, α-, B-, and γ-$LiAlO_2$ were obtained. A mixture of Li_2CO_3-K_2CO_3 and a mator phase of α-$LiAlO_2$ was obtained by heat treatment of alumina, Li_2CO_3, and Li_2CO_3-K_2CO_3 at 875 to 975°K for 23 to 90 h; this material is not suitable for electrolyte structures.

6003 **Method for fabricating boron carbide articles.** Ardary, Z.L. (to Dept. of Energy). US Patent Application 956,317. 31 Oct 1978. 8p.

The fabrication of boron carbide articles having length-to-diameter or width ratios greater than 2 to 1 is described. The process consists of hot pressing boron carbide powder into article segments or portions in which the segments have a length-to-diameter or width ratio less than 1.5, aligning a plurality of the initially hot-pressed segments in a hot-pressing die with the end surfaces of the segments placed in intimate contact with one another, and then hot pressing the aligned segments into an article of the desired configuration. The resulting article exhibits essentially uniform density throughout the structure with the bonds between the segments being equivalent in hardness, strength, and density to the remainder of the article.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 5269, 5440, 6009

6004 (CONF-7909101—2) **Energy of <100> coincidence twist boundaries in transition metal oxides.** Wolf, D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From 3. europhysical topical conference on lattice defects in ionic crystals; Canterbury, UK (17 Sep 1979).

The energies of coincidence twist boundaries formed by rotation about a <100> axis in stoichiometric transition metal oxides crystallizing in the NaCl structure (such as NiO, MnO, and CoO) have been calculated using the ionic-type potentials for these materials. From a relaxation calculation it is found that the energies of the most prominent coincidence twist boundaries at 36.87, 22.62, 28.07, and 16.26° (which correspond to inverse coincidence-site densities of Σ = 5, 13, 17, and 25, respectively) lie above the energy of the free [100] surface. The reason arises from the repulsive Coulomb interactions between ions in configurations close to anti-coincidence (anion on anion or cation on cation) which are capable of overcoming the attractive Coulomb interactions between the ions in coincidence configurations (cation on anion and vice versa). It is concluded that in contrast to metals the structures of <100> twist boundaries in oxides and alkali halides may not simply be derived from the coincidence lattice geometry. Entropy terms are not considered.

6005 **a<100> dislocations in magnesium oxide.** Narayan, J. (Oak Ridge National Lab., TN). *Philos. Mag.;* **37**: No. 4, 571-574(1978).

Dislocations of a<100> Burgers vector lying in [100] planes have been observed in magnesium oxide using transmission electron microscopy. The evidence for climb of these dislocations is presented.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 5266, 5272, 5274, 5275, 5276, 5277, 5281, 5298, 5683, 5721, 5878, 5972, 6000, 6003

6006 (GEPP-OP—440) **Degradation studies on erbium dideuteride thin films.** Holloway, D.M. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1979. Contract EY-76-C-04-0656. 44p. Dep. NTIS, PC A03/MF A01.

Rare earth metals are used as hydrogen isotope occluders and function as electrodes in neutron generator tubes. In this study, erbium dideuteride thin films have been quantitatively measured for purity in order to establish the deleterious effects resulting from film processng. These processes include deposition, hydriding and neutron tube vacuum anneal. The data taken reveals that ~ 0.02 mg/cm² erbium metal is unavailable as the hydride due to surface oxidation and interfacial interactions between occluder metal and substrate.

6007 (HEDL-SA—1833-FP) **Physically based model for helium release from irradiated boron carbide.** Beyer, C.E.; Hollenberg, G.W.; Duran, S.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 22p. (CONF-791045—6). Dep. NTIS, PC A02/MF A01.

From American Ceramic Society conference; New Orleans, LA, USA (14 Oct 1979).

The model is based on the nucleation of nonequilibrium helium bubbles under high pressures. The bubbles subsequently act as traps and grow as the result of gas atom diffusion. Model predictions are compared with bubble densities, sizes, and helium release characteristics of irradiated boron carbide.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 5273, 5887, 6002, 6004

6008 (CONF-790917—17) **Photoelectron spectra of actinide compounds.** Veal, B.W.; Lam, D.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 20p. Dep. NTIS, PC A02/MF A01.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

A brief overview of the application of photoelectron spectroscopy is presented for the study of actinide materials. Phenomenology as well as specific materials are discussed with illustrative examples. (FS)

6009 (CONF-7909101—1) **Isotope effect for cation diffusion in CoO.** Peterson, N.L.; Chen, W.K. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From 3. europhysical topical conference on lattice defects in ionic crystals; Canterbury, UK (17 Sep 1979).

The simultaneous diffusion of ^{55}Co and ^{60}Co has been measured in CoO as a function of equilibrium oxygen pressure in the range $10^{-8} < P/sub\ O_2/ < 1$ atm at 1200°C. The scope of the log D/sub Co/* vs log P/sub O_2/ plot changes from a value of about 1/4 at high P/sub O_2/ to about 1/5 at low P/sub O_2/ in agreement with the extensive measurements of Dieckmann. The isotope effect is independent of P/sub O_2/, which suggests that diffusion by defect clusters, interstitial Co ions and impurity-induced defects is not important in the present measurements. Conductivity diffusion, stoichiometry, and isotope-effect results are consistent with diffusion by neutral, singly charged, and doubly charged vacancies; the relative contributions from the various vacancies varies with P/sub O_2/.

6010 **Low frequency Raman scattering from ammonium ions in sodium beta-alumina.** Bates, J.B.; Kaneda, T.; Wang, J.C. (Oak Ridge National Lab., TN). *Solid State Commun.;* **25**: No. 9, 629-632(1978).

Based on isotopic frequency shifts and model calculations, bands observed near the region of 155 cm^{-1} in Raman spectra of sodium beta-alumina containing ammonium ions have been assigned to translational modes of NH_4^+. The spectra of a crystal containing 61% NH_4^+ ions show a pair of bands at 165 and 145 cm^{-1} (11 K). Possible origins of these bands are discussed.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 5238, 5269, 5271, 5280, 5281, 5675, 5881, 5883, 5887, 6093

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 5721

COMPOSITE MATERIALS

6011 (CONF-791014—, pp VI.43-VI.46) **Exploratory research on silicon nitride composites.** Fischbach, D.B. (Univ. of Washington, Seattle). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

PREPARATION AND FABRICATION

6012 **Method of making V_3Ga superconductors.** Dew-Hughes, D. (to Dept. of Energy). US Patent Application 967,178. 6 Dec 1978. 12p.

An improved method for producing a vanadium-gallium superconductor wire having aluminium as a component is disclosed. The wire is encased in a gallium bearing copper sheath. The superconductors may be fabricated under normal atmospheres and room temperatures by forming a tubular shaped billet having a core composed of an alloy of vanadium and aluminum and an outer sheath composed of an alloy of copper, gallium, and aluminum. Thereafter the entire billet is swage reduced to form a wire and heat treated to form a layer of V_3Ga in the interior of the wire.

MECHANICAL PROPERTIES

6013 (RHO-C—27) **Creep and cycling tests: thermal properties of Hanford concretes.** Gillen, M. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Mar 1979. Contract EY-76-C-14-2170. 23p. Dep. NTIS, PC A02/MF A01.

Four tests were conducted to determine thermal properties of concrete core material from the Purex Building at Hanford, Washington, and from concrete cast at the Portland Cement Association. Specific heat, thermal conductivity, and thermal diffusivity were measured as functions of temperature from 79 to 1175F.

6014 (RHO-C—28) **Elastic and strength properties of Hanford concrete mixes at room and elevated temperatures.** Abrams, M.S.; Gillen, M.; Campbell, D.H. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). Mar 1979. Contract EY-77-C-06-1030. 111p. Dep. NTIS, PC A06/MF A01.

The effects of long-term exposure to elevated temperatures on the physical properties of concrete mixes used in Hanford radioactive waste storage tanks were determined. Temperature had a significant effect on the elastic modulus of concretes. Poisson's ratio determined by the sonic method remained relatively constant. The splitting tensile strength increased rapidly up to 190 days of age. Then strength decreased to about 350 days and either leveled off or increased from that point on. Compressive strength data were erratic. (FS)

6015 (SAND—79-0176C) **Transverse compressive testing of thick Kevlar/epoxy laminates.** Guess, T.R.; Ericksen, R.H. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-791116—3). Dep. NTIS, PC A02/MF A01.

From 11. national SAMPE technical conference; Boston, MA, USA (Nov 1979).

A test program was performed to define a suitable geometry for measuring the transverse compressive properties of Kevlar 49 cloth/epoxy composites. Two geometries and strain measuring methods were evaluated: straight-sided cylinders with strain calculated from total platen displacement (includes specimen end effects), and reduced-section cylinders with strain measured in the reduced gage region (no end effects). The straight-sided specimens had length to diameter ratios between 1.1 and 2.7 and were tested with their ends both dry and lubricated. Neither the aspect ratio nor the end condition had a significant effect on measured compressive properties: stress-strain response and strength. At stress levels below failure, the stress-strain curves from the reduced-section samples were in good agreement with the straight-sided specimen data. Curves from both geometries lie within the same scatter band. Strength data from the reduced-section specimen were inconclusive. Based on this study, straight-sided cylinders with aspect ratios between 2.25 and 2.50 were selected as suitable specimens for characterizing the transverse compressive properties of thick Kevlar cloth/epoxy laminates.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 6013

6016 (DOE/TIC—10271) **Thermal stress test of GPHS aeroshell material.** Grinberg, I.M.; Luce, R.G.; Hulbert, L.E.; Fischer, R.D. (Battelle Columbus Labs., OH (USA)). Oct 1979. Contract W-7405-ENG-92-094. 38p. Dep. NTIS, PC A03/MF A01.

A thermal stress test was conducted to determine the ability of the GPHS aeroshell 3-D FWPF material to maintain physical and mechanical integrity when exposed to a severe heat flux environment such as would occur from prompt reentry of GPHS modules. The thermal stress test was conducted in the Giant Planetary Facility (GPF) at NASA's Ames Research Center (ARC). In collaboration with Los Alamos Scientific Laboratory (LASL) GPHS project staff, Battelle designed a test model compatible with GPF size requirements. The test model was fabricated by LASL. Battelle designed, fabricated, installed, and checked out a unique strain measuring transducer to fit in the cavity of the test specimen. Preliminary thermal and thermal stress analyses of the test specimen were conducted by Battelle. These analyses showed that the GPF facility could easily reach heating rates that would produce temperatures and stresses in the test specimen of the same order as those computed in the GPHS module aeroshell for prompt reentry.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 5800

6017 (COO—5011-4) **Sulfate specifications as a constraint to gypsum addition to cement and possible replacement of gypsum as an additive. Quarterly technical progress report, June-August 1979.** Kantro, D.L. (Portland Cement Association, Skokie, IL (USA)). Oct 1979. Contract EW-78-C-02-5011. 20p. Dep. NTIS, PC A02/MF A01.

Potential alternatives to gypsum for controlling set in commercial cement, additives to deter sulfate-induced expansion, and the influence of clinker manufacture on expansion potential in cements were studied. If limitations on sulfate content were less restrictive, it would be possible to use kiln fuels with higher sulfur contents, and to employ energy efficient preheater kiln technology without risk of exceeding sulfate specifications. (FS)

MECHANICAL PROPERTIES

6018 (SAND—79-0455) **Wear resistance and flexural strength of dental stone.** DeLollis, N.J. (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 14p. Dep. NTIS, PC A02/MF A01.

Dental stone is a quick-setting plasterlike material used for making solid castings. The possibility of improving the properties of this material by impregnating with organic resins has been investigated. The wear resistance and flexural strength were measured before and after impregnation with various resin formulations. It was found that it is possible to obtain four-fold improvement in wear resistance.

RADIATION EFFECTS

6019 (CONF-791102—14) **Effects of radiation at 5 K on organic insulators for superconducting magnets.** Coltman, R.R. Jr.; Klabunde, C.E.; Kernohan, R.H.; Long, C.J. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF AO1.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Recent studies of the effects of irradiation at 5 K on organic insulators for fusion reactors have extended the irradiation dose from 2 x 10^9 to 1 x 10^{10} rads and have looked for changes due to fast neutrons. For radiation conditions in this experiment the latter had little effect upon electrical and mechanical properties. At a dose of 1 x 10^{10} rads, particle-filled epoxies are at "end of life" in terms of mechanical strength, while fiberglass-cloth-filled epoxies retain sufficient strength for use. Electrical-resistivity and voltage-breakdown vaues are reduced in some materials but remain in a usable range. Two sheet-type materials show excellent stability in their electrical properties.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 5520, 5521, 5522, 5523, 5527

6020 (SAND—79-0387C) **Microstructural studies of thick film resistors using transmission electron microscopy.** Nordstrom, T.V.; Hills, C.R. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 14p. (CONF-791113—4). Dep. NTIS, PC A02/MF A01.

From ISHM conference; Los Angeles, CA, USA (13 Nov 1979).

The microstructure of thick film resistors of the duPont 1400 series fired on 96% Al_2O_3 at 850°C was characterized using transmission electron microscopy. Samples were prepared by a combination of precision grinding and ion milling. Each sample was examined for crystallinity, phase morphology, particle size, elemental composition and phase identification. X-ray energy dispersive spectroscopy was used for elemental composition determination and electron diffraction for phase identification. Microstructure of the 1421 (10^2 Ω/square) material is composed mainly of crystallites (< 100 nm) of lead bismuth ruthenate in a lead bismuth silicate glass. The 1461 (10^6Ω1/square) material is composed of lead ruthenate crystals in a lead silicate glass along with quartz crystals. For both resistors most crystallites are surrounded by the glassy phase.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 5521, 6020, 6337

PROPERTIES

REFER ALSO TO CITATION(S) 5716, 6008, 6023, 6276, 6337

6021 (COO—1198-1280) **Low temperature thermal conductivities of glassy carbons.** Anderson, A.C. (Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-02-1198. 9p. (CONF-791134—3). Dep. NTIS, PC A02/MF A01.

From 16. international thermal conductivity conference; Chicago, IL, USA (7 Nov 1979).

The thermal conductivity of glassy carbon in the temperature range 0.1 to 100°K appears to depend only on the temperature at which the material was pyrolyzed. The thermal conductivity can be related to the microscopic structure of glassy carbon. The reticulated structure is especially useful for thermal isolation at cryogenic temperatures.

6022 **Electrical conductivity of sandstone, limestone, and granite.** Duba, A.; Piwinskii, A.J.; Santor, M.; Weed, H.C. (Univ. of California, Livermore). *Geophys. J. R. Astron. Soc.;* **53**: 583-597(1978).

The electrical conductivity of cylindrical cores of Westerly granite, Indiana limestone and Nugget, St Peter and Kayenta sandstones was measured at about 25°C in vacuo, in air, and after saturation in distilled water, tap water, and 0.1 M NaCl solution. The three-electrode technique with a guard ring and the two-electrode technique without ε guard ring were used. Core aspect ratio over the range of 2.00 to 0.25, as well as frequency over the range of 50 Hz to 10 kHz, influences the conductivity of all rocks, especially those measured in vacuo. Measurements from water-saturated samples using a guard ring are not appreciably different from those obtained without a guard ring. The conductivity of rocks saturated in 0.1 M NaCl solution changes least with a change in aspect ratio; for these rocks a linear relationship, known as Archie's Law, exists between log porosity and log conductivity. No simple correlation was found between those factors in rocks saturated with tap or distilled water. Thus, it appears Archie's Law is of questionable value for correlating laboratory data from rocks saturated with low-conductivity fluids.

RADIATION EFFECTS

6023 (LBL—9793) **Transient annealing of GaAs by electron and laser beams.** Golecki, I.; Nicolet, M.A.; Tandon, J.L.; Ashbeck, P.M.; Sadana, D.K.; Washburn, J. (California Inst. of Tech., Pasadena (USA); Rockwell International Corp., Thousand Oaks, CA (USA). Science Center; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 10p. (CONF-791017—13). Dep. NTIS, PC A02/MF A01.

From 7. international conference on chemical vapor deposition; Los Angeles, CA, USA (14 Oct 1979).

Results of pulsed electron beam and ruby laser irradiations of high- and low-dose implanted layers in GaAs were studied. Ruby laser and electron beam irradiations result in peak concentrations higher than can be obtained in furnace annealing. Mobilities after transient annealing are usually lower as compared to conventional annealing. Implantation at doses below the 10^{13} cm^{-2} level show poor or no electrical activity after transient annealing. (FS)

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 5423, 6152

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 5395

6024 (BNL—26819) **Body composition as measured by in vivo neutron activation analysis.** Cohn, S.H.; Sawitsky, A.; Vartsky, D.; Yasumura, S.; Zanzi, I.; Gartenhaus, W.; Ellis, K.J. (Brookhaven National Lab., Upton, NY (USA); Long Island Jewish-Hillside Medical Center, New Hyde Park, NY (USA)). 1979. Contract EY-76-C-02-0016. 16p. (CONF-790990—1). Dep. NTIS, PC A02/MF A01.

From Meeting on nutritional assessment-present status, future directions and prospects; Santa Fe, NM, USA (24 Sep 1979).

A large scale study is currently underway on the changes in body composition resulting from the cachexia of malignancy. The ultimate objective of the overall project is to assess the changes in body composition associated with hyperalimentation and other modes of nutritional support to cancer patients. The first phase of this study is now in progress. In this phase, a study is being made of a control group of normal patients to provide baseline data against which data from cancer patients can be evaluated. Total body nitrogen and potassium are measured in a group of normal men and women, and are analyzed as a function of age. Additionally, changes in skeletal mass (total body calcium) are also recorded, and body water is measured simultaneously with the use of tritiated water.

6025 (LA-UR—79-2759) **Measurement of plutonium oxalate in thermal neutron coincidence counters.** Marshall, R.S.; Erkkila, B.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 10p. (CONF-791049—16). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A coincidence neutron counting method has been developed for assaying batches of plutonium oxalate. Using counting data from two concentric rings of ^3He detectors, corrections are made for the effects that water has on the coincidence neutron count rate. Batches of plutonium oxalate varying from 750 to 1000 g of plutonium and from 34 to 54% water are assayed with an average accuracy of +- 3%.

CHEMICAL PROCEDURES

6026 (FE—2710-6) **Instrumental analysis of sulfur compounds in coal process streams. Quarterly technical progess report, January-March 1979.** Jordan, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Apr 1979. Contract EF-77-S-01-2710. 29p. Dep. NTIS, PC A03/MF A01.

A synopsis of progress during January-March 1979 is presented. The electro-oxidation of thiosulfate to tetrathionate by a two-electron abstraction process at a rotated glassy carbon disk anode yielded well-defined differential pulse voltametric peak signals (Δi/sub max/). At submillimolar concentration levels in aqueous solution, Δi/sub max/ was proportional to $[S_2O_3^{--}]$. Cyclic voltametry

at a stationary carbon disk anode revealed that benzothiophene was electrooxidizable in an anhydrous acetonitrile solvent. The effective heat of precipitation of barium sulfate from aqueous solution was found to be invariant in a range of pH between 4 and 10. The applicable formal reaction enthalpy assignment is given. Using algorithms based on thermodynamic considerations and on Pourbaix Diagrams, a computer program has been prepared in ANSI standard BASIC for quantitatively predicting the mole fractional abundances of H_2S, HS^-, S^{--}, SO_2, HSO_3^-, SO_3^{--}, HSO_4^-, and SO_4^{--} in aqueous coal process streams. The program listings are user oriented requiring the input of readily measurable experimental data viz. pH, redox potential and temperature.

6027 (LA—7958) **Determination of thorium in plutonium-thorium oxides and carbides.** Walker, L.F.; Temer, D.J. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

Thorium is determined in (PuTh)C and $(PuTh)O_2$ by complexometric titration with ethylenediaminetetraacetic acid (EDTA) following separation on anion-exchange resin. Carbides are first oxidized by ignition in air at about 800°C. Oxide or oxidized carbide samples are dissolved in acids by the sealed-reflux technique or by heating in beakers. The plutonium is selectively sorbed from the 12M hydrochloric acid solution of the fuel on a Bio-Rad AG1-X2 anion-exchange resin column, and the eluted thorium is titrated with EDTA using xylenol orange as the indicator. The average recovery of thorium in 20 samples is 99.98% with a relative standard deviation of 0.07%.

6028 **Automated gravimetric titrator for the determination of uranium in safeguards materials.** Moran, B.W. (Dept. of Energy, Argonne, IL). *Nucl. Technol.;* **46**: No. 1, 98-104(Nov 1979).

An automated gravimetric titration system for uranium has been developed, evaluated, qualified for analysis in the laboratory's Quality Assurance Program, and placed in daily operation for the analysis of uranium-bearing safeguards samples at the New Brunswick Laboratory (NBL). The system, a direct application of the NBL Modified Titrimetric Method, is capable of nearly doubling the output of an analyst, while maintaining a mean percent error and relative standard deviation of $< 0.10\%$ over the range of 15 to 150 mg of uranium. The system is capable of analyzing all sample materials analyzed by manual titration at NBL with comparable degrees of accuracy and precision.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 5395, 5428, 5429, 6180, 6239, 6240

6029 (MLM—2676(OP)) **Radiochemical determination of uranium, thorium and lead-210 in coal and coal ash.** Casella, V.R.; Bishop, C.T.; Glosby, A.A.; Phillips, C.A. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 7p. (CONF-791049—20). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

A radiochemical procedure is presented for the sequential determination of uranium, thorium, and lead-210 in coal and coal ash. The procedure consists of dry ashing the sample, a nitric-hydrofluoric acid dissolution, removal of iron with ether extractions, and separation of the elements of interest by anion exchange chromatography. Uranium and thorium isotopes are measured by alpha spectrometry, while lead-210 is measured by beta counting its daughter, bismuth-210. For 10-g coal samples and 1-g coal ash samples, the chemical yields for the radioactivities measured were 70 to 80%, and the relative standard deviations for replicate analysis were generally less than 9%. The deviations of the means from the reference values were usually less than +-5%.

6030 (SAND—79-1681) **Design and construction of a prototype vaporization calorimeter for the assay of radioisotopic samples.** Tormey, T.V. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 101p. Dep. NTIS, PC A06/MF A01.

A prototype vaporization calorimeter has been designed and constructed for use in the assay of low power output radioisotopic samples. The prototype calorimeter design was based on that of a previous experimental instrument used by H.P. Stephens, to establish the feasibility of the vaporization calorimetry technique for this type of power measurement. The calorimeter is composed of a mechanical calorimeter assembly together with a data acquisition and control system. Detailed drawings of the calorimeter assembly are included and additional drawings are referenced. The data acquisition system is based on an HP 9825A programmable calculator. A description of the hardware is provided together with a listing of all system software programs. The operating procedure is outlined, including initial setup and operation of all related equipment. Preliminary system performance was evaluated by making a series of four measurements on two nominal 1.5W samples and on a nominal 0.75W sample. Data for these measurements indicate that the absolute accuracy (one standard deviation) is $\approx$ 0.0035W in this power range, resulting in an estimated relative one standard deviation accuracy of 0.24% at 1.5W and 0.48% at 0.75W.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 5395

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 6176

6031 (CONF-791092—1) **Recovery of SF_6 from air-SF_6 mixtures using sorption on activated charcoal.** Jones, C.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From Symposium of northeastern accelerator personnel; Philadelphia, PA, USA (8 Oct 1979).

An activation charcoal column can be used to selectively adsorb SF_6 from an air - SF_6 mixture. Appropriate adsorption and desorption temperatures are -45°C and +100°C, respectively. (DLC)

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 6026

6032 (PB—289450) **Reduction of nitric oxide with metal sulfides. Final report, June 1972-May 1978.** McCandless, F.P.; Hodgson, K. (Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering). Nov 1978. 97p. NTIS PC A05/MF A01.

The report gives results of research to determine the technical feasibility of using metal sulfide for the chemical reduction of NOx to N2. Nineteen different metal sulfides were investigated, using a test gas of pure NO. Although most sulfides resulted in some NO reduction, BaS, CaS, SrS, and FeS were the most promising. Several catalysts reduced the temperature at which the reduction process proceeds by as much as 200 C. A further temperature reduction was obtained by impregnating the sulfide and catalyst on high surface area supports of activated alumina or molecular sieves. The most promising catalysts were NaF, NiC 12, and FeC 12. All combinations of the most promising sulfide and catalysts were tested for NO reduction, using a synthetic flue gas containing 1000 ppm NO and 1% O2. The capacities of the six best were FeS-FeC 12 > SrS-NaF > CaS-NaF > BaS-FeC 12 > FeS-NiCl > CaS-FeC 12, and ranged from 0.0372 to 0.0134 g NO reduced/g initial sulfide present. Capacities of 0.91 and 0.76 g NO/g sulfide were obtained when using 5% CaS (only) impregnated on alumina and molecular sieves, respectively. It was concluded that these sulfides can reduce NO in the presence of O2, but more research is required to establish the economic feasibility.

6033 (UCRL—15114) **Thermal diffusivity of liquids determined by flash heating of a three-layered cell. Report No. 79-10.** Farooq, M.M. (California Univ., Davis (USA). Dept. of Mechanical Engineering). 15 May 1979. Contract W-7405-ENG-48. 93p. Dep. NTIS, PC A05/MF A01.

An investigation of the applicability of the flash method and a three-layered cell for determining the thermal diffusivity of liquids at temperatures between their melting and boiling points is described. Two different cell designs were developed for containing a liquid as the central layer - one involving brazing and the other bolted flanges. Test units were fabricated from stainless steel 304. Experiments were conducted with water and a high temperature heat transfer salt known as Hitec. Thermal diffusivity values were calculated by comparison of rear surface temperature measurements with the one-dimensional transient temperature variation in a three-layered cell subjected to an exponential heat pulse at the front surface. This procedure requires accurately known thermal properties of the cell walls. Thermal diffusivity results for water obtained with two brazed cells and one bolted cell were all within +- 1.0% of standard reference values. Results at the same temperature obtained for Hitec with two brazed cells were within +- 2.5% of each other over the temperature range of 149 to 427°C. Although lower by about 16% at 149°C, experimental values approached those given by the manufacturer at the upper end of the temperature range.

6034 **Preparation and monolayer properties of surfactant tris(2,2'-bipyridine)ruthenium(II) derivatives.** Valenty, S.J.; Behnken, D.E.; Gaines, G.L. Jr. (General Electric Co., Schenectady, NY). Contract EG-77-C-02-4395. *Inorg. Chem.;* **18**: No. 8, 2160-2164(Aug 1979).

The synthesis, characterization, and monolayer properties of three ruthenium bipyridyl complexes possessing hydrolytically stable

surfactant linkages and differing molecular charges are described: (Ru/sup II/(bpy)$_2$[bpy($C_{19}H_{3992}$])$^{2+}$, 2; (Ru/sup II/(bpy)(CN)$_2$[bpy($C_{19}H_{39}$)$_2$])^0, 3; and (Ru/sup II/[bpy(COO^-)$_2$]$_2$[bpy($C_{19}H_{39}$)$_2$])$^{2-}$, 4. Field-desorption mass spectra are reported for these and other nonvolatile ruthenium bipyridyl complexes. While the monolayer absorption spectra show no significant changes (except for iodide), both the surface pressure-area (II-A) isotherms and luminescence spectra of 2 are strongly dependent on dissolved anions; perchlorate is observed to condense the films and provide higher emission intensity as compared to chloride. Such effects are unique to the interfacial environment and are not observed in homogeneous solutions of 2. In contrast, the II-A isotherm and luminescence of 3 are independent of anion. The II-A isotherm of 4 does not show significant differences for subphases containing either Na^+ or Ca^{2+}. The emission intensity and maximum of 4 in 20% aqueous THF solution are pH dependent.

6035 Triosmium cluster compounds containing isocyanide and hydride ligands. Crystal and molecular structure of (μ-H)(μ-eta^1-C==N(H)(t-C_4H_9))$Os_3(CO)_{10}$. Adams, R.D.; Golembeski, N.M. (Yale Univ., New Haven, CT). Contract ER-78-S-02-4900. *Inorg. Chem.;* **18**: No. 8, 2255-2258(Aug 1979).

The crystal and molecular structure of the compound (μ-H)(μ-eta^1-C==N(H)(t-C_4H_9))$Os_3(CO)_{10}$ has been determined by X-ray crystallographic methods. The compound crystallizes in the centrosymmetric monoclinic space group $P2_1/n$[C/sub 2h/^{5}]:a = 13.651 (4) A, b = 9.156 (4) A, c = 18.275 (5) A, β = 111.42 (2)°, V = 2126.3 (25) A^3, Z = 4, rho/sub calcd/ = 2.92 g cm^{-3}. A uniform triangular cluster of three osmium atoms contains ten linear carbonyl groups and a μ-eta^1-C==N(H)(t-C_4H_9) iminyl ligand. The carbon atom of the iminyl ligand symmetrically bridges one osmium-osmium bond, as is shown by the internuclear separations Os(2)-C(11) = 2.066 (8) A and Os(3)-C(11) = 2.043 (8) A. The iminyl bond, C(11)-N, is double with the C-N distance being 1.298 (10) A.

6036 (LA-tr—79-41) **Thermodynamics and statistical mechanics of some hydrides of the lanthanides and actinides.** Mintz, M.H. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Aug 1979. Translation of NRCN—398, Jun 1976. 155p. Dep. NTIS, PC A08/MF A01.

This work deals mainly with the thermodynamic and physical properties of the hydrides of the lanthanides and actinides. In addition, statistical models have been developed and applied to metal-hydrogen systems. A kinetic study of the uranium-hydrogen system was performed. The thermodynamic properties of the hydrides of neptunium, thorium, praseodymium, neodymium, samarium, and europium were determined. In addition the samarium-europium-hydrogen ternary system was investigated. Moessbauer effect measurements of cubic neptunium hydrides were interpreted according to a model presented. A comparison between the lanthanide and actinide hydrides concludes the work.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 6034, 6035

6037 (COO—2571-18) **Improvement and verification of fast reactor safety analysis techniques. Progress report, July 1-September 30, 1979.** Barker, D.H.; Wiberg, D.V. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 1979. Contract EY-76-S-02-2571. 26p. Dep. NTIS, PC A03/MF A01.

The physical properties of the initial and final liquid phase of the Dimethyl Sulfoxide-Acetyl Chloride reaction system with either Acetone or Benzene as solvent are reported together with the method of collection. These properties include heat capacity, thermal conductivity, viscosity, density, heat of vaporization and thermal coefficient of volumetric expansion. A method of interpolation between initial and final liquid properties is described.

6038 (DOE/ER/10339—1) **Metal-ammonia reduction and reductive alkylation of coal tar hydrocarbons and the ^{13}C NMR characterization and conformational analysis of the reduced products.** Rabideau, P.W. (Indiana Univ., Indianapolis (USA); Purdue Univ., Indianapolis, IN (USA)). Oct 1979. Contract AC02-79ER10339. 7p. Dep. NTIS, PC A02/MF A01.

Progress has been good, and it appears that recent discoveries will make significant contributions to the fundamental chemistry of metal/ammonia reduction as well as some of the chemical processes important to the depolymerization of coal. Contrary to previous work (and expectations based on familiar chemistry), a method for the 1,4-ring reduction of aromatic carboxylic esters was developed. Furthermore, the ester function promises to produce unprecedented regioselectivity in the reduction of polynuclear systems (in fact, regiospecificity in ethyl biphenyl-4-carboxylate). It was found that 2,3-benzotriptycene will produce ring reduction or carbon-carbon bond cleavage depending on reaction conditions. This is the only system like this that we are aware of, and should allow study of factors that favor one pathway over the other. This is significant since the latter process (cleavage) is presumably the most important in the reductive depolymerization of coal.

6039 Fuel oils containing N,N-substituted diamines. Alink, B.A.O.; Thompson, N.E.S. (to Petrolite Corp.). US Patent 4,163,646. 7 Aug 1979. Filed date 30 Dec 1976. 12p.

This invention relates to the hydrogenation of tetrahydropyrimidines to yield linear N-substituted diamines which can be reacted with carbonyls to form imines, which imines can be reduced to N,N'-substituted diamines as illustrated by N,N'-substituted 2,4-diamino-2-substituted pentanes. The product of this invention are useful as fuel additives.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 5799

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 6041, 6187

6040 (SAN—113/21-1) **ESR studies of thiyl free radicals in relation to biological effects of radiation. Termination report.** (University of Southern California, Los Angeles (USA)). [nd]. Contract EY-76-S-03-0113-021. 33p. Dep. NTIS, PC A03/MF A01.

This report consists of three parts: (1) generation of the RS free radical in a solid state adamantane matrix under isotropic conditions by photolysis: signal identity reevaluation; (2) absorption spectroscopy study of RS free radical formation from reaction of cysteine with ceric ion; and (3) in vivo studies of free radicals using an extracorporeal blood loop-ESR technique. (DLC)

RADIATION CHEMISTRY

6041 (NDRL—2054) **Radiation Laboratory, University of Notre Dame quarterly report, July 1, 1979-September 30, 1979.** (Notre Dame Univ., IN (USA). Radiation Lab.). 15 Oct 1979. Contract EY-76-C-08-0038. 50p. Dep. NTIS, PC A03/MF A01.

Investigations in progress include: excess electron energy levels in liquid alkanes; dose and microdosimetric effects in radiation chemistry; dielectric relaxation and electron solvation in polar liquids; free-ion yield in liquid xenon induced by alpha-irradiation; slow electron moderation in rare gases; second-order properties; interactions of NO with aluminum; the use of real and model atoms for the same element cluster studies; thermal transformations of cis-1,2-dibenzoylalkenes; ESR studies of photoproducts in rubidium and metal-THF solutions; electronic absorption spectra of irradiated single crystals of phenol; optical studies of naphthyl radicals; oxidation of ferroxyanide by OH radicals; hydroxylation of phenylalanine; chemical dynamics of photo-produced carbonyl ylides; electron transfer reactions with solubilized metalloporphyrins in micelles; pulse radiolysis of Ni(II) macrocyclic complexes; photochemistry of iron(III) complexes with macrocyclic ligands; and charge transfer photochemistry of Cu(II) complexes with shift bases. Abstracts of papers and reports published during the quarter are included.

6042 Production of radiation crosslinked polymeric compositions using diacetylenes. Patel, G.N. (to Allied Chemical Corp.). US Patent 4,164,458. 14 Aug 1979. Filed date 7 Mar 1977. 8p.

Crosslinked polymeric compositions, useful as electrical insulators, heat shrinkable packaging, and lightweight foam plastics, are described. The crosslinked polymeric compositions are produced by admixing a diacetylene monomer, oligomer, polymer or mixture thereof, wherein the monomer has the formula, RNHCO-O-CH_2-C==C-C==C-CH_2-O-OCNHR' in which R and R' are the same or different and are alkyl containing 1 to 20 carbon atoms, with a thermoplastic crosslinkable polymer and then subjecting the resulting mixture to actinic radiation.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 6169

6043 (BNL—26812) **Hot cell for the synthesis of labelled organic compounds.** Fowler, J.S.; Karlstrom, K.; Koehler, C.; Lambrecht,

R.M.; MacGregor, R.R.; Ruth, T.J.; Sceviour, W.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 16p. (CONF-791103—43). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The design of a hot cell for use in labelling organic compounds is described. Versatility has been incorporated so that the cell can be used with a wide variety of organic syntheses as well as a large dynamic range of radioactivity (from μCi to Ci levels). This is made possible by having the large work area easily accessible from the front which can be opened or closed and a small sliding lead glass window and master slave manipulator. A variety of syntheses setups which have been modified for use in such a cell are described.

6044 (CONF-7909102—1) **EXAFS studies of actinide ions in aqueous solution.** Karim, D.P.; Georgopoulos, P.; Knapp, G.S. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

From Argonne specialists' workshop on basic research needs for nuclear waste management; Argonne, IL, USA (5 Sep 1979).

The applicability of the EXAFS technique in the study of actinide systems is discussed. Uranium L/sub III/-edge spectra obtained on an in-lab rotating anode EXAFS facility are presented and analyzed for crystalline UO_2F_2 and aqueous solutions containing hexavalent uranium ions. Methods for the extension of the technique to more dilute systems are discussed.

6045 (RFP—2901) **Soil decontamination at Rocky Flats.** Olsen, R.L.; Hayden, J.A.; Alford, C.E.; Kochen, R.L.; Stevens, J.R. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 1979. Contract EY-76-C-04-3533. 12p. (CONF-790923—6). Dep. NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

A soils decontamination project was initiated, to remove actinides from soils at Rocky Flats. Wet screening, attrition scrubbing with Calgon at high pH, attrition scrubbing at low pH, and cationic flotation were investigated. Pilot plant studies were carried out. Conceptual designs have been generated for mounting the process in semi-trailers. (DLC)

6046 **Covalency of neptunium(IV) tris(cyclopentadienyl) compounds from Moessbauer spectra.** Karraker, D.G.; Stone, J.A. (E.I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. *Inorg. Chem.;* **18**: No. 8, 2205-2207(Aug 1979).

Isomer shifts measured from the ^{237}Np Moessbauer spectra of $NpCp_3OR$ (R = alkyl), $NpCp_3R$, and $NpCpAr$ (Ar = aryl) are used as a measure of the covalency in Np(IV) ligand bonding. The isomer shifts in $NpCp_3$-n-Bu and $NpCp_3C_6H_4C_2H_5$ show a strong σ character for the Np-n-Bu and Np-$C_6H_4C_2H_5$ bonds. The σ character of Np-OR bonding is definite but less pronounced. The comparatively low covalency in the bonding of $NpCp_4$ is ascribed to longer Np-C bonds in $NpCp_4$ than in $NpCp_3^+$ compounds. The ^{237}Np isomer shift in $Np(MeCp)Cl_3 \cdot 2THF$ indicates that the MeCp ligand is σ-bonded in this compound.

6047 **Crystal and molecular structure of Bis[π-(cyclobutenocyclooctatetraene)]uranium(IV), $U[C_8H_8(CH_2)_2]_2$.** Zalkin, A.; Templeton, D.H.; Berryhill, S.R.; Luke, W.D. (Univ. of California, Berkeley). *Inorg. Chem.;* **18**: No. 8, 2287-2289(Aug 1979).

Crystals of bis[π-(bicyclo[6.2.0]deca-1,3,5,7-tetraene)]uranium(IV), $U[C_8H_8(CH_2)_2]_2$, are monoclinic: space group $P2_1/n$, a = 9.906 (8) A, b = 11.039 (9) A, c = 7.221 (6) A, β = 98.89 (5)°, V = 780.15 A^3, Z = 2, and D/sub x/ = 2.122 g cm^{-3} at 22°C. X-ray diffraction data were measured with counter methods and Mo Kα radiation. With anisotropic temperature factors for the uranium and carbon atoms and isotropic temperature factors for the hydrogen atoms, R = 0.020 for 1315 independent reflections (I > 3 σ). The molecule is a sandwich compound with the C_8 rings in an eclipsed configuration about the uranium atom which is on a center of symmetry. The average U-C distance is 2.64 +- 0.02 A, and the average C-C distance in the C_8 ring is 1.39 +- 0.01 A (uncorrected for thermal motion). The cyclobuteno ring is planar and at an angle of 6.8° to the plane of the C_8 ring. The C-C bond length is 1.47 (2) A in the -CH_2-CH_2- moiety, and it is 1.55 (2) A where this group is fused to the C_8 ring.

RADIOISOTOPE PRODUCTION

6048 (MLM—2677(OP)) **Polonium-209: a new source of analytical tracer.** Figgins, P.E.; Casella, V.R.; Bishop, C.T.; Glosby, A.A. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 12p. (CONF-791049—19). Dep. NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

Polonium-208, currently used as a tracer for polonium-210 determinations, is scarce and expensive. The nuclear properties indicate polonium-209 would have advantages as a tracer. A small amount of polonium-209 is formed during the neutron irradiation of bismuth-209 to form polonium-210. Short-lived polonium-210 decays out leaving polonium-209. Ten-year-old polonium foils were examined by GeLi counting and showed a definite spectrum of polonium-209. Alpha pulse height analysis of one sample showed polonium-209 to be 99% of the total count. This tracer was tested in the analysis of environmental samples.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

6049 (AD-A—064586) **Some infra-red applications in combustion technology. Interim report 1 March-31 August 78.** Swithenbank, J.; Turan, A.; Taylor, D.S. (Sheffield Univ. (UK). Dept. of Fuel Technology and Chemical Engineering). 1978. 15p. NTIS, PC AA02/MF A01.

Infrared technology finds many applications in the field of combustion ranging from pollution monitoring, through military systems, to the control of industrial furnaces and boilers. This review of some selected concepts highlights the interaction between the diagnostic role of infrared measurements and the current status of mathematical modelling of combustion systems. The link between measurement and and computing has also evolved to the point where a digital processor is becoming an inherent part of many new instruments. This point is illustrated by reference to the diffraction particle size meter, fire detection and alarm systems, and furnace control. In the future, as fuels become scarce and expensive, and micro-electronics become more available and inexpensive, it is certain that infrared devices will find increasing application in smaller industries and the home. (Author)

6050 (AD-A—064837) **Multiangular scanning absorption-emission techniques for three dimensional combustion diagnostics. Annual technical report 1 September 1977-30 August 78.** Goulard, R. (George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science). Dec 1978. 32p. NTIS, PC AA03/MF A01.

Absorption techniques are being applied to three-dimensional combustion diagnostics. By using multiagular scanning, the traditional 'onion-peeling' method can be extended from axisymmetrial flows to arbitrary distributions of radicals and pollutants in the flow. Since Scattering 'point' techniques are limited by their very small cross section, such an extension would be a step improvement in sensitivity, down to low radical concentrations. Convolution Fourier transforms and iterative algorithms have already been proven in X-Ray absorption tomography and interferometric application.

6051 **Fuel spray vaporization in humid environment.** Law, C.K.; Binark, M. (Northwestern Univ., Evanston, IL). *Int. J. Heat Mass Transfer;* **22**: No. 7, 1009-1020(Jul 1979).

The vaporization and transport of a monodisperse fuel spray in a cold, humid environment are analyzed, allowing for the possibility that the water vapor may condense, either heterogeneously at the droplet surface or homogeneously in the gas medium, as the spray interior is chilled through fuel vaporization. Results show that the associated condensation heat release is substantial and can significantly enhance the fuel vaporization rate, especially for the heterogeneous mode. It is further found that after initiation of vaporization the droplet temperature rapidly approaches a characteristic, constant value with heterogeneous condensation; this renders analytical solution possible. Potential complicatons caused by water condensation during spray experimentation are also discussed.

6052 **Recent NO/sub x/ research at IGT.** Waibel, R.T. Chicago, IL; Institute of Gas Technology (1979). 25p. (CONF-791070—1).

From American flame research committee meeting; Houston, TX, USA (22 Oct 1979).

The factors affecting NO/sub x/ emissions are discussed, and the data from research programs illustrating these effects are given. NO/sub x/ emissions from combustion can be formed by thermal oxidation of the nitrogen in the combustion air, commonly termed thermal NO/sub x/, or by oxidation of nitrogen in the fuel, termed fuel NO/sub x/. For liquid fuels the nitrogen is generally chemically bound in heterocyclic aromatic structures. Natural gas and cleaned low-Btu gases contain no fuel nitrogen and thus only produce thermal NO/sub x/. Low-Btu gases that are not subject to post-gasifier cleaning will contain ammonia and other fuel nitrogen compounds and thus produce fuel NO/sub x/.

ENGINEERING

GENERAL ENGINEERING

6053 (K/CSD/TM—29(Rev.1)) **Description of data entry for automated cost estimating.** Van Wie, N.H. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). Oct 1979. Contract W-7405-ENG-26. 40p. Dep. NTIS, PC A03/MF A01.

A series of computer programs has been developed to aid the personnel of the UCC-ND Estimating Engineering Department in the computational and reporting phases of preparing a project cost estimate. These programs are operative on any project, regardless of scale, as long as a minimal set of rules for preparation of the data base is followed. The data base for a project is subdivided into three types of data or files: a title file, a nucleus file, and a file of cost sheets with optional schedules. This document describes the data requirements and formatting specifications for preparation of these files so as to enable computation. Examples are presented and alternative approaches to accomplish an end result are explained. This document replaces and makes obsolete all prior internal correspondence related to data entry specifications. In particular, Revision 1 eliminates the need for a separately maintained data base for time-phased estimates and adds a capability to specify decimal inputs, the time unit of the labor rate and quantity, and the precision of output reporting associated with the data base. 11 figures, 3 tables.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 6145

6054 (COO—4122-28) **Extension of the Vaughan-Florence analysis of dynamic buckling of a rigid-plastic cylindrical shell.** Horvay, G.; Veluswami, M.A. (Massachusetts Univ., Amherst (USA). Dept. of Civil Engineering). 1979. Contract EY-76-S-02-4122. 21p. Dep. NTIS, PC A02/MF A01.

The paper contrasts the results of the HVS analysis based on the full equation, with those of the VF analysis, for a steel core support barrel representative of industrial nuclear powerplant practice. It is found that the decrease in criticality is not as spectacular as it is for the aluminum test shell of VF. For the latter one finds A/sub HVS, peak//A/sub VF, peak/ = 37%, whereas for the steel shell the ration is 61%. (In both cases the value of the critical mode number changes insignificantly when going from VF to HVS.) The reason for the diminished improvement in the case of the steel shell: the greatly diminished value for steel, as constrasted with aluminum, of the ratio E/sub t// σ of strain hardening modulus to yield stress.

6055 (COO—4122-29) **Dynamic buckling of a rigid-plastic cylindrical shell: a second order differential equation subject to four boundary conditions. Final report.** Zak, K.; Veluswami, M.A.; Horvay, G. (Massachusetts Univ., Amherst (USA)). 1979. Contract EY-76-S-02-4122. 23p. Dep. NTIS, PC A02/MF A01.

Three methods of solution are considered: (1) power-series expansion (in conjunction with Pade approximants); (2) cosine-series solution, and its pair obtained by the variation of parameters method; and (3) pseudo-Hill analysis. But only (1) is carried to completion, including a numerical confirmation that, for the aluminum test shell of Vaughan-Florence, the results coincide with those of Horvay-Veluswami-Stockton, based on time-consuming (and expensive) numerical forward integration. (2) is stopped short of numerical calculations; (3) is outlined in its principal features. The paper concludes with comments on post-buckling behavior.

6056 (Juel—1576) **Contribution to thermochemical water splitting processes with cycles of the chlorine family. Hydrolysis of magnesium chloride and experiments on the release of oxygen by chlorination of the magnesium hydroxide chloride produced.** Schulte, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Feb 1979. 141p. (In German). Dep. NTIS (US Sales Only), PC A07/MF A01.

Thesis. Submitted to Technische Hochschule, Aachen, Germany.

For the production of oxygen from water by means of a thermochemical cycle, the hydrolysis of magnesium chloride in a gas stream in the temperature range of 200 to 600°C and the chlorination of the produced substance with a magnesium hydroxide chloride content of 97.8% have been invest gated. Besides these gas-solids reactions, the conversion of magnesium hydroxide chloride and magnesium oxide with chlorine in an aqueous phase has been accomplished, too. The magnesium perchlorate-containing solutions obtained were decomposed at temperatures of 368 to 628°C with simultaneous oxygen production. By repeated chlorination of the residues in an aqueous phase a magnesium perchlorate solution was regained, which likewise produced oxygen by pyrolysis with yields between 61.0 and 92.2%. The feasibility of this closed half-cycle with one solution reaction could thus be demonstrated successfully under recycling conditions.

6057 (ORNL/TM—7009) **System software for the ORNL version of GIFTS 4B.** Gray, W.H. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 105p. Dep. NTIS, PC A06/MF A01.

The Oak Ridge National Laboratory (ORNL) maintains a version of the GIFTS system structural analysis computer program modules. Presented herein are the local software enhancements for the ORNL version of GIFTS as well as a description of the ORNL implementation of the system-dependent portions of the GIFTS software library.

6058 (SAND—79-0836) **Aerodynamic design of an extended-range guided bomb.** Maydew, R.C. (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 38p. Dep. NTIS, PC A03/MF A01.

The Extended-Range Guided Bomb is designed to provide a low altitude, return-to-target (RTT) delivery capability from aircraft at release speeds from 330 to 800 KCAS. The rocket-boosted, 41.9-cm (16.5-in.)-dia bomb utilizes two orthogonal pairs of pneumatically-actuated canards for attitude control and lift. The guidance and control system consists of a stepdown inertial measurement unit and a digital computer containing an autopilot and navigator. Carrier aircraft compatibility severely constrained the size and shape of the canard lifting/control surfaces. Computer simulations indicated the canards must provide high lift with nearly linear characteristics to angles of attack of about 20°. Extensive wind-tunnel tests were conducted to optimize the canard design. The measured wind-tunnel lift of the canard baseline design agrees well with the vortex-flow theories developed by Polhamus, Lamar, and coworkers at NASA Langley Research Center. Two flight tests (an unpowered stand-off and a rocket-boosted RTT) of instrumented full-scale vehicles released from an A7 aircraft at the Sandia Laboratories Tonopah Test Range, NV verified the aerodynamic design as well as the guidance and control system concepts.

6059 (SAND—79-1347C) **Comparison of first and second order techniques for computing optimal horizontal gliding trajectories.** Williamson, W.E. Jr. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 17p. (CONF-800104—2). NTIS, MF A01.

From 18. AIAA aerospace sciences meeting; Pasadena, CA, USA (14 Jan 1980).

The problem of numerically computing maximum endurance subsonic gliding trajectories which remain in a horizontal plane and return to the original starting point is considered. The control is parameterized and numerical solutions for two different types of parameterization are shown. Piecewise continuous polynomial control approximations are shown to produce consistent results for the trajectories which should be very good approximations for the true optimal solution.

6060 (SAND—79-2178) **Internal pressure measurements on the Sandia Powder Gun.** Asay, J.R.; Butcher, B.M.; Konrad, C.H. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

Measurements of the peak pressures occurring in the breech and impact chamber of the Sandia Powder Gun have been made for powder loads to 9 kg, and are compared with calculations based on a computer code for predicting internal ballistics of guns. Generally, good agreement is observed between the experimental and calculated results.

6061 (UCID—18226) **Users manual for SAP4: a modified and extended version of the U.C. Berkeley SAPIV code.** Sackett, S.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1979. Contract W-7405-ENG-48. 191p. Dep. NTIS, PC A09/MF A01.

SAP4 is a finite element code for the static and dynamic analysis of linear elastic structures. It is based on the April 1974 version of the SAPIV code developed at U.C. Berkeley by Bathe, Wilson, and Peterson. While maintaining the same basic structure as SAPIV, SAP4 contains extensive modifications to improve the input format and I/0 efficiency, and to support general restart capability and graphics postprocessing from a single compact data base. In addition, the following features have been implemented: dynamic memory allocation to ensure minimal memory usage for each problem; internal bandwidth/profile minimization; single Fourier mode capability for axisymmetric solids; near incompressible behavior for 3D solids; automatic normal rotation constraints for flat plates/shells; a general beam-type stiffness/flexibility element; consistent mass lumping by shape function weighting of element mass assignments; and piecewise exact integration for modal time history analysis. Several programs are available to aid in preparing SAP4 input and to produce time history and geometry plots of the analysis results. They are discussed, along with some simple examples.

6062 (Y/DX—02) **Pulse-width-modulated amplifier drives for machine tools.** Barkman, W.E. (Oak Ridge Y-12 Plant, TN (USA)).

Nov 1979. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

The function of a dc servo controller is to convert command and feedback information into an error signal that is used to drive a dc motor. To accomplish this, the controller utilizes a summing technique that compares an input-command voltage with a feedback voltage from an external transducer. The resultant error signal is applied to a linear or a switching servo amplifier. While the output of the linear amplifier may have the ideal representation of the desired drive signal, it does result in substantial power dissipation within the amplifier and requires forced-air cooling for power ratings above 100 to 200 W. The switching amplifier avoids this problem by rapidly changing the state of its output stage from a conducting to a nonconducting condition, thereby minimizing the operation of the output stage in the high power-dissipation region. The design and operation of the amplifier drive are described. (TFD)

6063 (JPRS—74588) USSR report: Engineering and equipment, No. 62. 16 Nov 1979. Translation of various articles. 48p. NTIS.

Articles, abstracts, and news items published in the USSR on aeronautical, marine, mechanical, automotive, civil and industrial engineering, related research and development, and engineering materials and equipment are presented.

6064 Data acquisition system. Phillips, D.T. (to Dept. of Energy). US Patent 4,156,809. 29 May 1979. Filed date 7 Feb 1978. 6p.

PAT-APPL-875,822.

The invention relates to a data acquisition system capable of resolving transient pulses in the subnanosecond range. A pulse in an information carrying medium such as light is transmitted through means which disperse the pulse, such as a fiber optic light guide which time-stretches optical pulses by chromatic dispersion. This time-stretched pulse is used as a sampling pulse and is modulated by the signal to be recorded. The modulated pulse may be further time-stretched prior to being recorded. The recorded modulated pulse is unfolded to derive the transient signal by utilizing the relationship of the time-stretching that occurred in the original pulse.

6065 Titanium nitride thin films for minimizing multipactoring. Welch, K.M. (to Dept. of Energy). US Patent 4,151,325. 24 Apr 1979. Filed date 22 Oct 1976. 10p.

PAT-APPL-734,841.

The invention discloses a method and apparatus for applying a thin film coating to the surface of a workpiece, in particular, applying a coating of titanium nitride to a klystron window by means of a crossed-field diode sputtering array. The array is comprised of a cohesive group of numerous small hollow electrically conducting cylinders and is mounted so that the open ends of the cylinders on one side of the group are adjacent a titanium cathode plate. The workpiece is mounted so as to face the open ends of the other side of the group. A magnetic field is applied to the array so as to be coaxial with the cylinders and a potential is applied across the cylinders and the cathode plate, the cylinders as an anode being positive with respect to the cathode plate. The cylinders, the cathode plate and the workpiece are situated in an atmosphere of nitrogen which becomes ionized such as by field emission because of the electric field between the cylinders and cathode plate, thereby establishing an anode-cathode discharge that results in sputtering of the titanium plate. The sputtered titanium coats the workpiece and chemically combines with the nitrogen to form a titanium nitride coating on the workpiece. Cas pressure, gas mixtures, cathode material composition, voltages applied to the cathode and anode, the magnetic field, cathode, anode and workpiece spacing, and the aspect ratio (ratio of length to inner diameter) of the anode cylinders, all may be controlled to provide consistent optimum thin coatings of various compositions and thickness. Another facet of the disclosure is the coating of microwave components per se with titanium nitride to reduce multipactoring under operating conditions of the components.

6066 Method for forming a thermocouple. Metz, H.J. (to Dept. of Energy). US Patent 4,148,134. 10 Apr 1979. Filed date 12 Oct 1977. 2p.

PAT-APPL-841,413.

A method is provided for producing fast response, insulated junction thermocouple having a uniform diameter outer sheath in the region of the measuring junction. One step is added to the usual thermocouple fabrication process that consists in expanding the thermocouple sheath following the insulation removal step. This makes it possible to swage the sheath back to the original diameter and compact the insulation to the desired high density in the final fabrication step.

6067 Coupling for joining a ball nut to a machine tool carriage. Gerth, H.L. (to Dept. of Energy). US Patent 4,148,235. 10 Apr 1979. Filed date 28 Mar 1978. 6p.

PAT-APPL-891,097.

The invention relates to an improved coupling for joining a lead screw ball nut to a machine tool carriage. The ball nut is coupled to the machine tool carriage by a plurality of laterally flexible bolts which function as hinges during the rotation of the lead screw for substantially reducing lateral carriage movement due to wobble in the lead screw.

6068 Annular flow diverter valve. Rider, R.L. (to Dept. of Energy). US Patent Application 963,654. 24 Nov 1978. 9p.

The invention relates to valves useful both for flow divergence and flow convergence and more particularly to servocontrolled annular flow diverter valves which are also useful in the reverse direction for flow mixing. In more detail, the invention relates to a valve capable of splitting a single inflowing stream into two separate and distinct outflowing streams wherein one of the outflowing streams follows the original flow path and the other outflowing stream follows a flow path immediately surrounding the first flow path. The valve operating on fluid flow in the reverse direction can also act as a controllable device capable of mixing two fluids flowing from a concentric system into the inner tube. Specifically, the invention relates to a valve for diverting flow from the center of two concentric tubes to the annulus between the tubes and for controlling the volume ratio of the flows.

6069 Experiments on fluidelastic vibration of cantilevered tube bundles. Chen, S.S.; Jendrzejczyk, J.A. (Argonne National Lab., IL). *J. Mech. Des.;* **100**: 540-548(Jul 1978).

Results are presented of three series of experiments on coupled tube/fluid vibration. Natural frequencies and mode shapes of coupled modes as well as steady-state responses are measured for each tube bundle. An analysis is also made for each test. Experimental data and analytical predictions are found to be in good agreement.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 5876, 5954, 6012, 6019, 6361, 6362

6070 Superconducting transistor. Gray, K.E. (to Dept. of Energy). US Patent 4,157,555. 5 Jun 1979. Filed date 7 Nov 1977. 8p.

PAT-APPL-849,201.

A superconducting transistor is formed by disposing three thin films of superconducting material in a planar parallel arrangement and insulating the films from each other by layers of insulating oxides to form two tunnel junctions. One junction is biased above twice the superconducting energy gap and the other is biased at less than twice the superconducting energy gap. Injection of quasiparticles into the center film by one junction provides a current gain in the second junction.

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 6235

6071 Enhancement of air filtration using electric fields. Nelson, G.O.; Bergman, W.; Miller, H.H.; Taylor, R.D.; Richards, C.P.; Biermann, A.H. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Am. Ind. Hyg. Assoc. J.;* **39**: 472-479(Jun 1978).

Polarized electrostatic air filters (PEAF) have been used for several years with varying success. The design of PEAF involves placing a filter (usually glass fiber) in a strong electric field (5 to 10 kV/cm). When particles enter the electric field, they become polarized (but not charged as they do in an electrostatic precipitator) and experience a new force toward the regions of highest electrical field intensity which occur at the fiber surface. Increasing the electric field increases the attracting force. This process of filtration can supplement the more common mechanisms of filtration such as diffusion, interception, and impaction. One 1974 study showed that PEAF could decrease the penetration of 1.0 and 0.3 μm dioctylphthalate (DOP) aerosols by two orders of magnitude. The purpose of the study was to expand this experimental work and the theortical work involving electrostatic air filtration. The design of specially insulated screens that not only maintain high electric potential, but require less than 0.2 $Wm^{-3}s$ (0.1 W/1000 cfm) even when collection liquid or metal aerosols is given. The use of PEAF as a prefilter in nuclear facilities is anticipated. It is believed that the use of these filters would lead to a significantly increased service-life of high efficiency particulate air (HEPA) filters. (TFD)

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 5421

6072 (HEDL-SA—1888-FP) Capabilities and application of existing hot cells at the Hanford Engineering Development Laboratory. Pember, L.A.; Gruber, W.J.; McMahan, M.E.; Weber, E.T. (Han-

ford Engineering Development Lab., Richland, WA (USA)). Jun 1979. Contract EY-76-C-14-2170. 13p. (CONF-791103—50). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Hanford Engineering Development Laboratory operates two hot cell facilities, the Postirradiation Testing Laboratory, and the Shielded Materials Facility. The hot cell facilities provide a wide range of capabilities for postirradiation examination and testing of irradiated reactor fuels and structural materials to evaluate irradiation tests and determine failure mechanisms and effects of irradiation on physical and mechanical properties of reactor core components. Current functions performed include non-destructive examinations, destructive examinations, fabrication of test specimens from reactor core components, fabrication of reactor test assemblies containing irradiated fuel pins or structural material samples, and shipping and receiving radioactive materials.

6073 (LA-UR—79-3091) **History of remote handling at the Los Alamos Scientific Laboratory.** Wilson, M.T.; Wood, W.T.; Barnes, J.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 29p. (CONF-791103—55). Dep. NTIS, PC A03/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The handling of high levels of radioactive materials began at Los Alamos in 1944 with the receipt of ^{140}Ba sources that were milked to extract the ^{140}La daughter for use as a tracer in hydrodynamical experiments. Remote-handling techniques and facilities have been used to support research programs in reactor development and radiochemistry, and in support of an accelerator.

6074 (NUREG/CR—1008) **Reference critical experiments. Progress report, April 1, 1979-June 30, 1979.** Goebel, G.R.; Oh, I.; Rothe, R.E. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Oct 1979. Contract EY-76-C-04-3533. 22p. (RFP—2990). Dep. NTIS, PC A02/MF A01.

This is the fifteenth in the series of quarterly progress reports describing reference critical experiments being performed at the Critical Mass Laboratory at Rockwell International's Rocky Flats Plant for the US Nuclear Regulatory Commission (NRC). The results of eight critical experiments are reported using the low-enriched, damp (H/U ~ 1.25) uranium oxide (U_3O_8) in the concrete reflector and the minimal steel reflector. The oxide alone is not critical; hence, a high-enriched (93% U-235) uranium driver section near the core center was required. The drivers used in these experiments were a uranium metal sphere, high concentration uranyl nitrate solution, and low concentration uranyl nitrate solution.

6075 (UCID—18180) **Operating manual for the electrostatic glove-box prefilter installed inside the filter glove box No. 046 at Rocky Flats, Building 776.** Bergman, W.; Kaifer, R.C.; Hebard, H.D.; Taylor, R.D.; Lum, B.Y. Boling, R.M.; Buttedahl, O.I.; Woodard, R.W.; Terada, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 11 May 1979. Contract W-7405-ENG-48. 76p. Dep. NTIS, PC A05/MF A01.

Objective of the evaluation is to evaluate the effectiveness of the electrostatic prefilter in prolonging the life of HEPA (high-efficiency particulate-air) filters. The theory of the electrostatic filter is reviewed, and Glove Box Number 046 is described in detail, followed by a description of the electrostatic prefilter used in the present application. Engineering drawings of the electrostatic prefilter are included. The procedure for evaluating the electrostatic prefilter includes the steps for conducting five different tests: evaluating (1) the HEPA filter alone, (2 and 3) the HEPA filter with a standard prefilter treated both as disposable and reusable, and (4 and 5) the HEPA filter with the electrostatic prefilter, again treated as disposable and reusable. Procedures for flowmeter calibrations and measurements of particle-size distributions are also included. Long-term maintenence of the system during the evaluation program is outlined, and estimates of component durability are given. An electrical engineering safety note describes the high-voltage operational hazard of the electrostatic prefilter and the testing of safety devices (the current-overload trip circuit, the filter-door-interlock system, and the current-limiting resistor).

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 5433

6076 (LA—8081-MS) **Nuclear shipping container secondary impact analysis.** Straight, J.W. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

A computer code has been developed for determining the secondary or slapdown impact velocity of a nuclear shipping container that strikes an unyielding surface at a shallow angle. The slapdown velocity is of importance in assessing container safety because it (and therefore the damage potential) can be significantly higher than the initial impact velocity. Data from shallow-angle tests were used to benchmark many features of the code, and the correlation is typically within 10%. Although the availability of reliable data is very limited, the correlation is sufficient to warrant using the code as a design tool.

6077 (LA—8097-MS) **Endochronic viscoplasticity model.** Cook, W.A. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

The endochronic viscoplasticity model is presented, and the criteria for general problem analyses are discussed. Two approaches are then developed for inclusion of this model in nonlinear finite element codes. One approach includes reformulating the stiffness matrix for solution by iteration, and the other approach does not. Also, the uniaxial tension problem is studied, and the problems encountered with the use of this model are stated. Finally, recommendations are presented to check the basic postulates used to develop this model.

6078 (NUREG/CR—1066) **Dynamic analysis to establish normal shock and vibration of radioactive material shipping packages. Quarterly progress report, April 1-June 30, 1979.** Fields, S.R.; Mech, S.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1979. Contract EY-76-C-14-2170. 44p. (HEDL-TME—79-43). Dep. NTIS, PC A03/MF A01.

The objective of this study is to determine the extent to which the shocks and vibrations experienced by radioactive material shipping packages during normal transport conditions are influenced by, or are sensitive to, various structural parameters of the transport system (i.e., package, package supports, and vehicle). The purpose of this effort is to identify those parameters which significantly affect the normal shock and vibration environments so as to provide the basis for determining the forces transmitted to radioactive material packages. Determination of these forces will provide the input data necessary for a broad range of package-tiedown structural assessments. Progress during the reporting period is reported.

6079 **Fire resistant nuclear fuel cask.** Heckman, R.C.; Moss, M. (to Dept. of Energy). US Patent 4,147,938. 3 Apr 1979. Filed date 7 Feb 1978. 6p.

PAT-APPL-875,821.

The disclosure is directed to a fire resistant nuclear fuel cask employing reversibly thermally expansible bands between adjacent cooling fins such that normal outward flow of heat is not interfered with, but abnormal inward flow of heat is impeded or blocked.

MINING AND DRILLING EQUIPMENT AND FACILITIES

6080 (CONF-791014—, pp III.26-III.31) **Microstructural effects in abrasive wear.** Flore, N.F. (Univ. of Notre Dame, IN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6081 (SAND—78-1226) **Drilling technology development program: Fiscal Years 1977 to 1978.** Huff, C.F. (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 58p. Dep. NTIS, PC A04/MF A01.

Highlights of FY 1977 included successful diffusion bonding of polycrystalline diamond compacts (e.g., Stratapax) to studs and use of graphite granules as a pressure transfer medium in the diffusion bonding process. The PDC stud assemblies were tested in single point rock cutting experiments that demonstrated the competence of the bond in a fatigue environment. In the instrumentation project, a prototype model of a viscometer capable of measuring drilling mud properties at pressures and temperatures up to 20,000 psi (138 MPa) and 500°F (260°C) was completed. The first coatings were deposited on elastometers, showing some enhancement of their service life. Crack growth tests of steels in a sour-gas environment were completed, showing similar fatigue resistance for various techniques of heat treating drill string steels. During FY 1978, commercial sources of metallization for use in the diffusion bonding process were developed. Since the autoclaving is commercially available, the entire process can be accomplished by anyone capable of sealing the container under a high vacuum. The first bit was tested in a laboratory drilling environment. Penetration rates up to 100 fph at 100 rpm were achieved in Carthage Marble, and 72 ft of Sierra White Granite were drilled at rates averaging over 60 fph. The prototype model of the high temperature-pressure viscometer was tested in the laboratory and in the field. Additional coatings were applied to elastomers, and laboratory tests were conducted to determine the effect of the coatings on mechanical properties.

6082 **Seal.** Morrill, C.D. (to McEvoy Oilfield Equipment Co.). US Patent 4,109,942. 29 Aug 1978. Filed date 7 Apr 1977. 14p.

An oil well pipe suspension apparatus including a wellhead having a pipe hanger supported therein and a christmas tree supported thereon, a frusto-conical metal gasket providing a metal-to-metal

seal between the hanger and the wellhead, and an X cross section resilient metal gasket providing a metal-to-metal seal between the hanger and the christmas tree. 14 claims.

6083 **Multi-stage well-drilling mast assembly.** Howard, J.A.; Smith, R. Jr. (to BJ-Hughes Inc.). US Patent 4,109,800. 29 Aug 1978. Filed date 10 Oct 1973. 10p.

A multi-stage, well-drilling mast assembly, particularly adapted to mobile drilling platforms, such as drilling vessels, the assembly having a main stage mast and an auxiliary mast, both pivoted to the platform for swinging movements between horizontal and vertical positions. The main stage carries well pipe hoisting equipment, and the auxiliary stage carries rack equipment for vertically storing well pipe, and racker equipment for moving the well pipe between the rack and the center line of the mast assembly. Slings operated by the hoisting equipment swing the stages between horizontal and vertical positions. A low profile and a low center of gravity are achieved when the stages are horizontally disposed. The distribution of the weight of the hoist, the rack, and the rackers between the stages of the mast assembly provides a multi-stage mast assembly in which the individual stages may be conveniently swung between reclined and vertical, well-drilling positions. 20 claims.

6084 **Rotary drill bit.** Bovenkerk, H.P. (to General Electric Co.). US Patent 4,109,737. 29 Aug 1978. Filed date 24 Jun 1976. 10p.

A rotary drill bit for rock drilling comprising a plurality of cutting elements mounted by interference-fit in recesses in the crown of the drill bit. Each cutting element comprises an elongated pin with a thin layer of polycrystalline diamond bonded to the free end of the pin. 56 claims.

LASERS

REFER ALSO TO CITATION(S) 6091, 6278, 6379

6085 (AD-A—064394) **Photon statistics in two-mode lasers. Master's thesis.** Anderson, B.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 97p. NTIS, PC AA05/MF A01.

The evolution of the first and second moments of the photon density distribution for a twc-mode laser system was studied by proposing appropriate transition rate expressions and using the Kubo equations developed for a Chapman-Kolmogorov system. A numerical analysis technique was used in solving the rate equations and computer plots were generated for various combinations of laser parameter values. Anomalously large fluctuations, similar to those occurring in single-mode lasers, were observed during photon buildup of the modes. When only one mode was oscillating, a photon buildup in the non-lasing mode was seen to cause similar fluctuations in the lasing mode. In all cases, these fluctuations were accompanied by a strong linear relationship between the modes.

6086 (AD-A—064549) **Effects of cooperative atomic behavior on lasers. Annual report October 1977-September 1978.** Senitzky, I.R. (Technion-Israel Inst. of Tech., Haifa). Sep 1978. 26p. NTIS, PC AA03/MF A01.

The behavior of a pumped collection of identical three level atoms in which both the upper pair of levels and the lower pair of levels are coupled to resonant cavity-modes is analyzed. The cases of both incoherent pumping and coherent pumping are considered, and turn out to be qualitatively different. For the case of incoherent pumping, field oscillation can be sustained in only one of the modes, the behavior of the system being that of the familar three-level laser, with oscillation occuring between either the upper pair or lower pair of levels, depending on the relaxation constants. For the case of coherent pumping, however, oscillation can be obtained in both modes. Furthermore, this oscillation is different from that found in a parametric oscillator in the sense that, under certain conditions of operation, the phases of oscillation in the two cavities are independent. The potential application of such behavior is pointed out.

6087 (AD-A—064756) **Synthesis of the plasma chemistry occurring in high power CO_2 lasers. Master's thesis.** Toodle, D.E. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 94p. NTIS, PC AA05/MF A01.

The neutral chemistry of the following mixtures have been studied by using a quadrupole mass spectrometer and a theoretical model: CO_2/Ar, N_2/Ar, $CO_2/N_2/Ar$, $CO_2/He/Ar$, and $CO_2/N_2/He/Ar$. CO_2 dissociation occurs by direct electron impact and appears to depend on initial CO_2 concentration and mixture. Very little N_2 dissociation occurs in a pure N_2 discharge; however, dissociation of N_2 increases when it is added to a mixture containing CO_2. This dissociation is less than 1%. Consequently, the dominant nitrogen oxide in mixtures containing CO_2 and N_2 is NO, and the concentration of NO never exceeds 1%. The species CHO and CH_2O are present at high discharge currents if there is a small amount of water contamination in mixtures containing CO_2.

6088 (AD-A—064758) **High power continuous wave semiconductor injection laser. Master's thesis.** Griffin, J.C. III. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1978. 78p. NTIS, PC AA05/MF A01.

A review of fundamental semiconductor laser theory is presented, followed by a theoretical analysis of the figures of merit, which affect high power CW operation. It is postulated that high CW power of the order of several watts can be obtained from long lasers with low end reflectivities. The removal of heat from the junction region can be best accomplished in narrow lasers with a width near 50 micrometers. Further optimization of output power can be achieved in devices with a thin optical cavity. However, the optical cavity must be sufficiently thick to provide an output facet area large enough to accommodate high optical flux, without experiencing catastrophic damage. Diffused homojunction structures are not suitable for implementing these parameters. A large optical cavity, epitaxially grown heterostructure device appears to be the most suitable structure for high power CW operation. Trends in output power with varying laser length, width, reflectivity, and cavity thickness are presented graphically.

6089 (UCRL—15118) **Fluorescent line-narrowing studies of Nd: glass laser materials. Final report.** Riseberg, L.A.; Brecher, C. (GTE Labs., Inc., Waltham, MA (USA)). Aug 1979. Contract W-7405-ENG-48. 86p. Dep. NTIS, PC A05/MF A01.

During the last year of effort under Purchase Order No. 9506303, Fluorescence Line-Narrowing Studies of Nd: Glass Laser Materials, work was continued and completed, representing the culmination of a major multiyear effort to elucidate the spectroscopic and structural properties of rare earth doped glass laser materials. The final year of effort covered in this report was directed at three major areas of effort. First of all, the analysis of the Nd^{3+} decay kinetics was completed. Secondly, the rationalization of Eu^{3+} crystal field behavior with Nd^{3+} crystal field behavior in fluoroberyllate and fluorophosphate glass was pursued both theoretically and experimentaly. Structural modeling was refined and carried to completion for the Eu-doped fluoroberyllate system, and was initiated for the fluorophosplate. These activities are discussed in detail in subsequent sections.

6090 **Fabrication of off-axis parabolic mirrors.** Gerth, H.L.; Sladky, R.E.; Bezik, M.J.; Washington, C.A. (Union Carbide Corp., Oak Ridge, TN). *Opt. Eng.;* **17**: No. 6, 588-594(Nov 1978).

A fabrication process is now available that can manufacture focusing mirrors for the 10-kJ laser fusion experiment being conducted by the Los Alamos Scientific Laboratory. Techniques have been developed for satisfactory metal preparation, copper electroplating, single-crystal diamond turning, and optical inspection. Fabrication of these mirrors by these techniques, and a post diamond-turning polish, resulted in diffraction-limited optics at a wavelength of 10.6 μm.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 5779, 6063

6091 (N—78-22341) **Flow calculation in the high power laser wind tunnel: case of a discharge in a pure supersonic flow.** Jaeggy, B.C.; Jaeggy, G. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 18 Jan 1977. Contract DRME-74/397. 147p. (ISL-R—101/77). NTIS PC A07/MF A01.

The flow in the ISL high power CO_2 laser wind tunnel was investigated taking into consideration phenomena related to the excitation and vibration relaxation of the gas. The calculation was based on a theoretical model leading to a first order differential equation system of classical form which is solved by using the Runge-Kutta method. A detailed description is presented of the FORTRAN 4 computer program written for an IBM 370/135.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 5417, 5926, 6063

6092 (CONF-790757—3) **Nondestructive evaluation techniques for silicon carbide heat-exchanger tubing.** Kupperman, D.S.; Deininger, W.D.; Lapinski, N.P.; Sciammarella, C.; Yuhas, D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From ARPA/AF review of progress in quantitative NDE; La Jolla, CA, USA (8 Jul 1979).

Portions of document are illegible.

The adequacy of various nondestructive evaluation (NDE) techniques for inspecting silicon carbide heat-exchanger tubing is discussed. These methods include conventional ultrasonics, acoustic

microscopy, conventional and dye-enhanced radiography, holographic interferometry and infrared scanning techniques. On the basis of current test results and an examination of the discussions in available literature, these techniques were compared with respect to (a) effectiveness in detecting cracks, pitting, inclusions, and voids, (b) effectiveness in characterizing detected flaws, (c) adaptability to tube geometry, (d) adaptability to in-service inspection, (e) reliability, and (f) extent of development required for commercialization.

6093 (CONF-791014—, pp I.10-I.15) **Development and application on nondestructive test methods for coal conversion and utilization systems.** Ellingson, W.A.; Youngdahl, C.A.; Reimann, K.J.; Roberts, R.R. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6094 (HEDL-SA—1808-FP) **Acoustic emission: who needs it - and why?.** Spanner, J.C. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1979. Contract EY-76-C-14-2170. 27p. (CONF-790966—2). Dep. NTIS, PC A03/MF A01.

From International conference on acoustic emission; Anaheim, CA, USA (10 Sep 1979).

Acoustic emission (AE) is an emerging NDT method that offers attractive capabilities for monitoring structural integrity and characterizing materials behavior. Although its limitations are such that it should not be regarded as a panacea, AE is proving to be a viable complement to the other NDT methods. The paper examines the extent and reasons for the growing industrial interest in AE. Some of the inherent limitations of conventional NDT methods are discussed, and several surveys of defects found during the manufacture and operation of pressure boundary components are reviewed. Although welds and weld-affected areas are the most likely locations for significant defects, very little experience is available to date to describe the AE response during impending pressure vessel failures due to weld associated defects. Acoustic emission offers potential for providing increased assurance of both initial, and continued, structural integrity. Furthermore, if AE is properly applied in conjunction with recently proposed fitness-for-purpose criteria, it may be possible to reduce present manufacturing costs without compromising actual structural adequacy. This technology is exhibiting definite signs of increasing industrial maturity, as evidenced by the recent availability of industrial standards, and the activities of various AE related technical groups throughout the world.

6095 (LA-UR—79-2648) **Status of radiographic study, development, and new applications in the LASL Nondestructive Testing Group.** Bryant, L.E. Jr. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

Topics discussed include replacement of betatron with a racetrack microtron, development of tomography, cineradiography, and flash x ray, and new applications of flash x ray.

6096 (SAND—79-7047) **Non-destructive evaluation of stainless steel bellows and POCO graphite by means of the scanning laser acoustic microscope (SLAM). Technical report.** Yuhas, D.E.; McGraw, T.E.; Kessler, L.W. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Mechanical and Aerospace Engineering). Oct 1979. Contract EY-76-C-04-0789. 45p. Dep. NTIS, PC A03/MF A01.

An ultrasonic imaging inspection technique was developed for intact inspection of welded seams on stainless steel bellows at a frequency of 100 MHz. Two cylindrical bellows (outside diameter 6.5 and 1.0 inches) consisting of a series of convoluted, welded, metal rings were investigated. The report describes the imaging method, instrumentation, and data obtained. High resolution, magnified, acoustic images of the welded zones were obtained using a new stage to fit a Scanning Laser Acoustic Microscope (SLAM) that employes 100 MHz acoustic waves to create images of the weldment elastic-microstructure. These acoustic micrographs, which contain 2 x 10^4 image points, are displayed on a real-time TV monitor. Fixturing modifications to the SONOMICROSCOPE 100 and special transducers were developed to accommodate the complex bellows geometry. Examination of more than 140 inches of welded seams revealed a variety of flaws. These anomalous zones are classified according to flaw size, morphology, and degree of acoustic contrast. Acoustic micrographs illustrating the various flaw tyes are compared with results obtained by metallographs. Ultrasonic investigation of POCO graphite showed that samples in excess of 1/4" (6.25 mm) thick were found to be too attenuating for testing at 100 MHz. The results of this investigation indicate lower ultrasonic frequencies, in the 25 to 30 MHz range, will allow the required penetration of POCO graphite parts in this 1/4" thickness range.

6097 (UCRL-Trans—11520) **Report on the acoustic emission examination of glass-fiber-reinforced plastic pipes.** Brockmann, W.; Wolitz, K. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Bremen (Germany, F.R.). Inst. fuer Angewandte Materialforschung). Oct 1979. Translation source information not available. 18p. Dep. NTIS, PC A02/MF A01.

From the results reported, it can be concluded that acoustic emission analysis is suitable as a technique for quality control of high-pressure pipes, because it permits critical processes (fiber breaks) to be distinguished from noncritical processes (delamination, breaks between fibers) at pressure loads up to the rated load. If further tests with a larger number of test specimens can establish a statistically significant correlation between the proportion of fiber breaks below the rated pressure and the bursting pressure which actually occurs, it will be possible, by using acoustic emission analysis and test loads up to the rated pressure, to dispense with an individual test at double rated load, which in its own right can damage, beyond the critical point, a system designed for a load. The use of acoustic emission analysis thus leads to increased safety of the pipes.

SAFETY ENGINEERING

REFER ALSO TO CITATION(S) 6257, 6258

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 6070, 6338

6098 **Rapidly deployable emergency communication system.** Gladden, C.A.; Parelman, M.H. (to Dept. of Energy). US Patent 4,152,647. 1 May 1979. Filed date 23 Feb 1978. 10p.

PAT-APPL-880,818.

The invention discloses a highly versatile, highly portable emergency communication system which permits deployment in a very short time to cover both wide areas and distant isolated areas depending upon mission requirements. The system employs a plurality of lightweight, fully self-contained repeaters which are deployed within the mission area to provide communication between field teams, and between each field team and a mobile communication control center. Each repeater contains a microcomputer controller, the program for which may be changed from the control center by the transmission of digital data within the audible range (300-3,000 Hz). Repeaters are accessed by portable/mobile transceivers, other repeaters, and the control center through the transmission and recognition of digital data code words in the subaudible range.

6099 (DOE/RA—0041) **Measurement techniques for high power semiconductor materials and devices. Annual report, October 1, 1977-September 30, 1978.** (National Bureau of Standards, Washington, DC (USA). Electron Devices Div.). Oct 1979. 144p. (NBSIR—79-1756). Dep. NTIS, PC A07/MF A01.

Results of NBS research directed toward the development of measurement methods for semiconductor materials and devices which will lead to more effective use of high-power semiconductor devices in applications for energy generation, transmission, conversion, and conservation are reported. It responds to national needs arising from the rapidly increasing demands for electricity and the present crisis in meeting long-term energy demands. Emphasis is on the development of measurement methods for materials for thyristors and rectifier diodes. Application of this measurement technology will, for example, enable industry to make devices with higher individual power-handling capabilities, thus permitting very large reductions in the cost of power-handling equipment and fostering the development of direct current (dc) transmission lines to reduce energy waste and required rights-of-way. The major tasks under this project are to evaluate the use of thermally stimulated current and capacitance measurements and other deep level measurement techniques as a means for characterizing lifetime-controlling or leakage source defects in power grade silicon material and devices and to develop procedures to enable spreading resistance measurements of thyristor starting material and layer profiles to be made on a reliable basis.

6100 (GEPP-OP—469) **Determining the mode of high voltage breakdowns in vacuum devices.** Miller, H.C.; Furno, E.J.; Sturtz, J.P. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1979. Contract EY-76-C-04-0656. 22p. Dep. NTIS, PC A02/MF A01.

Photography, recording of the voltage waveform, and monitoring of the X ray output were used to investigate breakdown in vacuum. Results indicate that breakdowns may be divided into two types: (1) vacuum (interelectrode) breakdown - characterized by a diffuse moderately bright discharge, a relatively slow and smooth voltage collapse and a large burst of X rays, and (2) surface (insulator) flashover - characterized by a bright discharge with a very bright filamentary core, a relatively fast and noisy voltage collapse, and no X-ray burst. Thus, the results indicate that useful information concerning the type of breakdown in a vacuum device can be

obtained by monitoring the voltage (current) waveforms and the X-ray output.

6101 (NUREG/CR—0967) **Multiple property variations in coaxial cylindrical conductors determined with multiple-frequency eddy currents.** Deeds, W.E.; Dodd, C.V. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 63p. (ORNL/NUREG/TM—335). Dep. NTIS, PC A04/MF A01.

Since many factors can influence eddy-current readings, one must generally make readings on a given sample at several different frequencies to determine a particular factor unambiguously. To expedite and automate the taking of readings, computer programs were written that take simultaneous measurements of the magnitude and phase of the output voltage from an eddy-current pickup at several different frequencies on standards with known properties. Empirical formulas are then constructed from powers of various possible functions of the magnitude and phase readings, and the formulas are fitted to the desired properties of the material by a least-squares process. Finally, the empirical formulas are used with readings on unknown samples to determine their properties. The computer programs, written in FORTRAN IV, are especially designed to be used with coils coaxial with multiple layers of cylindrical conductors, possibly containing defects. However, the instrument calibrating, data taking, and formula fitting parts of the programs are actually applicable to any configuration of coils and conductors. The programs for the calibration, acquisition, and reduction of data have been used to take measurements at three different frequencies on tubular samples. Up to six different properties have been obtained simultaneously and accurately for each sample.

6102 (SAND—79-1647) **Microprocessor-controlled interface for the Nicolet Explorer III series digital oscilloscopes.** Smaardyk, J.E. (Sandia Labs., Albuquerque, NM (USA)). Sep 1979. Contract EY-76-C-04-0789. 47p. Dep. NTIS, PC A03/MF A01.

A microprocessor-controlled interface has been built to transfer digital data from a Nicolet Explorer III oscilloscope to a tape cassette-equipped terminal for transmission to the NOS computing facilities. The interface hardware is described with detailed schematic diagrams including the required modifications to the selected microprocessor kit. Program listings are provided for use in both permanent on-board storage (EPROM memory) and temporary storage (RAM memory). An example illustrates system operation and decoding and interpretation of the normalizing words. Finally, optional modifications are described to provide multiple transmission rates and a switch-selectable starting address capability.

6103 (JPRS—74569) **USSR report: Electronics and electrical engineering, No. 52.** 14 Nov 1979. Translation of various articles. 124p. NTIS.

Articles, abstracts, and news items published in the USSR on electronic materials, components, and devices, on circuit theory, pulse techniques, electromagnetic wave propagation, radar, quantum, electronic theory, development and devices, miniaturization techniques on electric power machinery, power transmission, and nuclear power developments are presented.

6104 **Microinterferometer transducer.** Corey, H.S. III. (to Dept. of Energy). US Patent 4,153,370. 8 May 1979. Filed date 5 Dec 1977. 6p.

PAT-APPL-857,650.

An air-bearing microinterferometer transducer is provided for increased accuracy, range, and linearity over conventional displacement transducers. A microinterferometer system is housed within a small compartment of an air-bearing displacement transducer housing. A movable cube corner reflector of the interferometer is mounted to move with the displacement gauging probe of the transducer. The probe is disposed for axial displacement by means of an air-bearing. Light from a single frequency laser is directed into an interferometer system within the transducer housing by means of a self-focusing fiber optic cable to maintain light coherency. Separate fringe patterns are monitored by a pair of fiber optic cables which transmit the patterns to a detecting system. The detecting system includes a bidirectional counter which counts the light pattern fringes according to the direction of movement of the probe during a displacement gauging operation.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 5236, 5340, 5674, 5689, 5924

6105 (CONF-791014—, pp V.1-V.4) **Hot corrosion erosion testing of materials for application to advanced power conversion systems using coal-derived fuels. Task II: fluidized bed combustion.** Nutkis, M.S. (Exxon Research and Engineering Co., Linden, NJ). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6106 (CONF-791014—, pp V.5-V.11) **Fireside corrosion. Task II: evaluation of heat exchanger materials for use in a coal-fired fluidized bed combustion environment.** Clark, J.W.; Spengler, C.J. (Westinghouse Electric Corp., Pittsburgh, PA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6107 (CONF-791014—, pp V.22-V.25) **Fluidized bed combustion: corrosion/erosion tests.** Minchener, A.J. (National Coal Board, Cheltenham, England). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6108 (CONF-791014—, pp V.49-V.53) **Heat exchanger materials for fluidized-bed coal combustors.** DeVan, J.H.; Godfrey, T.G. (Oak Ridge National Lab., TN). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6109 (CONF-791014—, pp V.54-V.58) **Corrosion of heat exchanger tubes in a fluidized bed coal reactor.** Stevenson, D.A.; Stringer, J. (Electric Power Research Inst., Palo Alto, CA). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6110 (CONF-791014—, pp V.56-V.58) **Corrosion tests of superheater alloys in a fluidized bed boiler.** 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6111 (CONF-791014—, pp V.59-V.61) **1000 hour corrosion test in a pressurized fluidized bed combustion facility.** 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

6112 (CONF-791014—, pp V.62-V.66) **Effects of sulfation accelerators on corrosion behavior of materials in atmospheric fluidized-bed combustion systems.** Chopra, O.K. (Argonne National Lab., IL). 1979.

From 4. annual conference on materials for coal conversion and utilization; Gaithersburg, MD, USA (9 Oct 1979).

UNDERGROUND ENGINEERING

6113 (PNL-TR—357) **Driving of gate roads with the Krupp 340 tunnel-cutting machine.** Arcypowski, M.; Troesken, K. Translated from *Glueckauf;* **107**: No. 23, 880-885(1971). 29p. Dep. NTIS, PC A03/MF A01.

The report describes the new machine and reports on the progress of driving two gate roads as well as on the driving performances achieved and the experience acquired. (TFD)

6114 (PNL-TR—358) **Tunnel driving with boom cutters.** Paurat, F.W. Translated from *Glueckauf;* **107**: No. 12, 443-446(1971). 16p. Dep. NTIS, PC A02/MF A01.

As recently as one year ago, there were still no boom cutters capable of working the entire cross section or even the crown height of large traffic tunnels. Heading machines of the type known in mining were being used to drive dome-shaped tunnels by sequential excavation. By combining hydraulic excavators with cutters from heading machines, it has been possible in the space of a year to market machines capable of cutting crown heights up to 7 m in one pass, and ultimately to develop such machines capable of driving the traffic tunnel in its entire height of around 11 m in one pass. This operating experience has been acquired in driving of traffic tunnels in Italy. Furthermore, a cushioned-roller support is described which should permit the machine working time to be improved in friable rock, both for heading machines and for tunnelling machines, because the final support is no longer installed in front of the machine, but is installed continuously behind the machine.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 5313, 5698

6115 (PB—292748) **Assessment of the use of fugitive emission control devices. Final report.** Daugherty, D.P.; Coy, D.W. (Research Triangle Inst., Durham, NC (USA)). Feb 1979. Contract EPA-68-02-2612. 86p. NTIS, PC AA05/MF A01.

The report compares the efficiencies and utility consumptions expected from three fugitive emission control techniques--building evacuation, charged fog sprays, and water sprays with additives--if they were applied in primary lead and copper smelters. Estimates are provided of the reduction of total suspended particulate emissions and the reduction of elemental lead emissions from smelters when fugitive control is applied. Charged fog water sprays are empha-

sized; they enhance particulate collection by putting an electrostatic charge on fine water droplets. Building enclosure and evacuation is used as a basis with which such water sprays are compared. Available cost and energy consumption data were used to assess the competitiveness of charged fog sprays. Charged fog sprays were found to be less efficient than building evacuation, but also less expensive and less energy intensive by about a factor of 10. Charged fog sprays cannot replace conventional smelter techniques (e.g., secondary hooding or building evacuation) because they are not suitable for the typical large-volume, high-temperature, turbulent air streams. They are better suited for smaller scale, localized emission sources (e.g., conveyor transfer points) which contribute only a fraction of the fugitive particulate emissions.

PARTICLE ACCELERATORS

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

6116 (LA—8096-MS) **General least-squares fitting procedures to minimize the volume of a hyperellipsoid.** Wadlinger, E.A. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

Several methods for determining the shape parameters, which in two dimensions are the Courant-Snyder parameters, and the volume of an ellipse or hyperellipse that represents a set of phase-space points in a two-or-more-dimensional hyperspace are presented. The ellipse parameters are useful for matching a beam to an accelerating or transport system and in studies of emittance growth. The fitting procedure minimizes the total volume of a hyperellipse by adjusting the ellipse shape parameters. The total volume is the sum of the individual particle volumes defined by the hyperellipse that passes through a particle's phase-space point. A two-dimensional space is considered first; then results are generalized to a higher number of dimensions. Computer programs using these techniques were written. 1 figure.

6117 (UCRL-Trans—1580) **Transport line between CRYEBIS and the accelerator tube.** Repoux, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1979. Translation source information not available. 8p. Dep. NTIS, PC A02/MF A01.

A summary description of the beam transport system between the CRYEBIS ion sources and the SATURNE accelerator tube is given. This includes discussion of the electrostatic steering and focusing, modulator, and electrostatic sector. A dipole is used to make the beam round before its entry into the solenoid used for spin rotation. (GHT)

6118 (UCRL-Trans—11503) **High-current accelerator with a plasma cathode.** Pedenko, N.S.; Lutsenko, E.I.; Fainberg, Ya.B. Translated from *Fiz. Plazmy Probl. Upr. Termoyad. Sin.;* No. 3, 30-33(1972). 9p. Dep. NTIS, PC A02/MF A01.

Experiments investigating an electron accelerator in a linear plasma betatron have showed that the redistribution of a voltage applied to a plasma on the cathode layer of the plasma, which results from the limited electron emission from the cold cathode, imposes a constraint on the value of the voltage that can be applied to a plasma located in a glass chamber. At voltages exceeding 80 to 100 kV, the glass breaks down and the vacuum is broken. The present paper investigates the problem of producing powerful electron beams from a linear plasma betatron designed for higher voltages. In order to increase the beam current, configuration of the magnetic field was used to obtain a plasma density distribution along the system such that a region with an elevated concentration - a plasma cathode - was formed in front of the accelerator.

AUXILIARIES AND COMPONENTS

ION SOURCES

REFER ALSO TO CITATION(S) 6123, 6274, 6293

6119 (UCRL-Trans—1579) **Basic characteristics of a confined electron beam source adaptable to a synchrotron: the Cryebis Project.** Arianet, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Aug 1979. Translation source information not available. 15p. Dep. NTIS, PC A02/MF A01.

The general characteristics of single-pulse EBIS sources, the basic data of a source design for Saturne II (CRYEBIS), and some considerations on future possibilities of a substantially more elaborate prototype are presented.

6120 (UCRL-Trans—1583) **Ionization cross sections and ion yields in a source with a confined electron beam.** Arianer, J.; MacFarlane, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Aug 1979. Translation of IPNO—76-03, May 1976. 17p. Dep. NTIS, PC A02/MF A01.

In a source of heavy ions with a confined electron beam, the simple scheme of producing very highly charged ions by successive ionization adequately accounts for the experimental phenomena involved. In the case of apossible application of this type of source to an accelerator, it is necessary to foresee for all the substances the number of ions and state of maximum charge that one can hope to obtain for a given list of parameters: electron density and intensity, energy, ionization volume, interaction time, etc. If the quantities characterizing the beam are known fairly well, the ionization cross sections are more or less closely simulated by theoretical formulas. A previous report used the so-called Becker-Schmidt formula, which was shown by Donets to be invalid. The aim here is not to propose a correct formula for the cross section, but rather to show what yield is likely to be provided by this type of source according to the type of machine that follows its, and what error is involved in this calculation when the Loetz semi-empirical formula advocated by Donets is employed.

6121 (UCRL-Trans—1585) **Result of tests on the FRECH 1 gun and definition of the FRECH 2 gun of the CRYEBIS source.** Goldstein, C.; Serafini, A.; Steinegger, A.; Dubois, P.; Guichard, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Aug 1979. Translation of IPNO—76-07. 19p. Dep. NTIS, PC A02/MF A01.

The operations currently performed on a Frost type gun which was built at SEA are summarized. This FRECH 1 gun (Frost scale 1) has a cathode 18 mm in diameter. It has been very satisfactory, with the voltages, currents, and densities obtained essentially conforming to the expectations. The specific operation conditions of the CRYEBIS source have led to a FRECH 1 homothetic gun having a 36-mm cathode (scale 2) pierced at its center so as to permit the injection of polarized neutral atoms. This FRECH 2 gun is presented, and the tests will have to be performed in the coming months.

INJECTION AND EXTRACTION SYSTEMS

6122 (CONF-791092—2) **Small, microcomputer-based CAMAC controller.** Juras, R.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Symposium of northeastern accelerator personnel; Philadelphia, PA, USA (8 Oct 1979).

The beam buncher necessary to condition the beam from the Oak Ridge National Laboratory 25 MV tandem accelerator for post-acceleration by the Oak Ridge Isochronous Cyclotron is CAMAC-based and will be controlled via one of the serial highways of the accelerator control system. However, prior to integration into the accelerator system, the buncher requires testing, including runs on the model EN tandem at Oak Ridge. In order to facilitate testing and initial operation of the buncher, a microcomputer-based controller was assembled. The controller consists of a CAMAC crate, several CAMAC modules, a touch panel display, a controller box, and software. The controller box contains one shaft encoder and two switches. One of the switches is a coarse/fine selector. The other switch is assignable via the touch panel display and is used, for example, to turn devices on and off. Operation of the controller is described. It can be quickly assembled to control any small CAMAC-based system. 2 figures. (RWR)

6123 (UCRL-Trans—1584) **Cryebis Project.** Arianer, J.; Goldstein, C. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Aug 1979. Translation of IPNO—77-02, 1977. 80p. Dep. NTIS, PC A05/MF A01.

The use of heavy ions in the new Saclay synchrotron Saturne II could open up new areas of research, particularly in nuclear astrophysics and radiobiology. The ion generator is made to produce particles with a charge to mass ratio of 0.5 so that they can be accelerated by the machine. The work of Donets has shown that a linear confinement source of type EBIS (electron beam ion source) can produce nuclei up to neon with a suitable intensity and a cycle that adapts perfectly to that of a synchrotron. The design of a source adaptable to Saturne II became common in 1975 with the fundamental idea that the confinement should also be used for accumulation of polarized particles. The fact that the source was placed on a high voltage (400 KV) platform has led (but this is not the only reason) to ample use of cryogenic techniques, whence its name: CRYEBIS (cryogenic electron beam ion source). This report justifies the options which were taken for the final design of CRYEBIS.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 6329

6124 (CONF-790882—2) **Radioisotope detection with the Argonne FN tandem accelerator.** Kutschera, W.; Henning, W.; Paul, M.; Stephenson, E.J.; Yntema, J.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From 10. international radiocarbon conference; Bern, Switzerland (19 Aug 1979).

A standard heavy ion nuclear structure facility has been used to detect several long-lived radioisotopes by counting the accelerated ions. The problem of eliminating strong isobaric background beams has been solved by combining the energy loss dispersion through a uniform Al foil stack with the high momentum resolution of an Enge split-pole magnetic spectrograph. Radioisotope concentrations in the following ranges have been measured: $^{14}C/^{12}C = 10^{-12}$ to 10^{-13}, $^{26}Al/^{27}Al = 10^{-10}$ to 10^{-12}, $^{32}Si/Si = 10^{-8}$ to 10^{-14}, and $^{36}Cl/Cl = 10^{-8}$ to 10^{-11}.

6125 (CONF-790923—8) **Decommisioning plan for particle accelerators.** Opelka, J.H.; Kikta, M.J.; Marmer, G.J.; Mundis, R.L.; Peterson, J.M.; Siskind, B. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

An assessment of the magnitude of the problem presented by the decommissioning of particle accelerator facilities is given. The history of past decommissionings is reviewed with regard to technological, environmental, health, and economic aspects. Development of a generalized plan for accelerator decommissioning is discussed. (GHT)

6126 (SLAC-PUB—2405) **Results from the Mark II detector at SPEAR: SLAC-LBL collaboration.** Lueth, V. (Stanford Linear Accelerator Center, CA (USA)). Sep 1979. Contract EY-76-C-03-0515;W-7405-ENG-48. 13p. (CONF-790885—7). Dep. NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

Recent results from the Mark II include measurements of the rho +- ν decay of the tau +- lepton, two-photon production of the eta'(958) meson, charmed meson decays, and the first observation of charmed baryons in e^+e^- annihilation. 19 figures, 4 tables.

6127 (UCRL-Trans—1581) **CRYEBIS source: description of the platform.** Chalfen, J.P. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Aug 1979. Translation source information not available. 8p. Dep. NTIS, PC A02/MF A01.

The containment platform for the CRYEBIS ion source at Saturne is described. Mechanical construction, design specifications, materials, and cage design are discussed. (GHT)

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 5405, 6128, 6242

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 5405, 6312

6128 **Total stabilization of an alpha spectrometry system.** Feldstein, J.; Fisenne, I.M. (Department of Energy, New York (USA). Environmental Measurements Lab.). *Health Phys.;* **36**: No. 1, 59-60(Jan 1979).

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 6292

RADIOMETRIC INSTRUMENTS

6129 (LA—8094-MS) **Influence of access hole parameters on neutron moisture probe readings.** Abeele, W.V. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

Computing soil moisture content with a neutron probe requires use of a calibration curve that considers the thermal neutron capture cross section of the hole liner, as well as the hole diameter. The influence of steel, polyvinyl chloride, and aluminum casings that fit 0.051- to 0.102-m hole diameters was determined by comparison with neutron probe readings in uncased holes of corresponding diameters. Eccentricity of probe location was considered a potentially significant variable. The experiment was run in disturbed Bandelier tuff with an average dry density of 1.35g . cm^{-3} and moisture content of 3.8 to 26.7% by volume. The casing material and hole diameter influenced the probe readings significantly, whereas eccentric location of the probe did not. Regression analyses showed an almost perfect inverse linear correlation between hole diameter and count rate.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

REFER ALSO TO CITATION(S) 6147

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 5290, 5293, 5779, 6030, 6145, 6398

6130 (GA-A—15496) **Development of a surveillance robot for dimensional and visual inspection of fuel and reflector elements from the Fort St. Vrain HTGR.** Wallroth, C.F.; Marsh, N.I.; Miller, C.M.; Saurwein, J.J.; Smith, T.L. (General Atomic Co., San Diego, CA (USA)). Nov 1979. Contract AT03-76ET35300. 11p. (CONF-791103—53). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A robotic device has been developed for dimensional and visual inspection of irradiated HTGR core components. The robot consists of a rotary table and a two-finger probe, driven by stepping motors, and four remotely controlled television cameras. Automated operation is accomplished via minicomputer control. A total of 51 irradiated fuel and reflector elements were inspected at a fraction of the time and cost required for conventional methods.

6131 (LA-UR—79-2832) **New ultra small battery operated portable multi-channel analyzer.** Wolf, M.A.; Umbarger, C.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 6p. (CONF-791037—4). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A newly designed portable multi-channel analyzer (MCA) has been developd at Los Alamos that has much improved physical and performance characteristics over previous designs. Namely, the instrument is very compact (25 cm wide x 14 cm deep x 21 cm high) and has a mass of 4.2 Kg (9.2 lb). The device has 1024 channels and is microprocessor controlled. The instrument has most of the standard features of present laboratory-based pulse height analyzers, including CRT display, region of interest integration, etc. Battery life of the MCA is nearly eight hours, with full charging over night. An accessory case carries a small audio cassette recorder for data storage. The case also contains two different NaI(Tl) detectors.

6132 (MHSMP—79-56) **Computer program for deconvolution of distribution curves.** Ashcraft, R.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1979. Contract EY-76-C-04-0487. 38p. Dep. NTIS, PC A03/MF A01.

A computer program for the IBM/360 was written to perform deconvolution of a distribution curve by nonlinear regression of the distribution to a summation of Gaussian components. An optical linear baseline may be included in the regression model, and the program allows up to five Gaussian components. Minimization of the sum of squared residuals is accomplished by use of a modified simplex method. The program provides statistical information about the regression, a residual table, and graphical output to aid the user in a analysis of the regression. A Gel Permeation Chromatography (GPC) distribution is included as a program application. 4 figures.

6133 (SAND—79-1092) **Sandia Mark II X-Ray System.** Morrison, L.W. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 39p. Dep. NTIS, PC A03/MF A01.

The Sandia Mark II X-Ray System was designed and developed to provide an intense source of mononergetic, ultra-soft x rays with energies between 0.282 and 1.486 keV. The x-ray tube design is similar to one developed by B.L. Henke and incorporates modifications made by Tom Ellsberry. An operations manual section is incorporated to help the experimenter/operator.

6134 **Expansible apparatus for removing the surface layer from a concrete object.** Allen, C.H. (to Dept. of Energy). US Patent 4,152,028. 1 May 1979. Filed date 24 Feb 1978. 4p.

PAT-APPL-880,920.

A method and apparatus for removing the surface layer from a concrete object are described. The method consists of providing a hole having a circular wall in the surface layer of the object, the hole

being at least as deep as the thickness of the surface layer to be removed, and applying an outward wedging pressure on the wall of the hole sufficient to spall the surface layer around the hole. By the proper spacing of an appropriate number of holes, it is possible to remove the entire surface layer. The apparatus consists of an elongated tubular-shaped body having a relatively short handle with a solid wall at one end. The wall of the remainder of the body contains a plurality of evenly spaced longitudinal cuts to form a relatively long expandable section. The outer end of the expandable section has an expandable, wedge-shaped spalling edge extending from the outer surface of the wall, perpendicular to the longitudinal axis of the body, and expanding means in the body for outwardly expanding the expandable section and forcing the spalling edge into the wall of a hole with sufficient outward pressure to spall away the surface layer of concrete. The method and apparatus are particularly suitable for removing surface layers of concrete which are radioactively contaminated.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 5352, 5353, 5399

6135 (INIS-mf—4683, pp 6-8) **Theoretical bases of radon tracer technique logging.** Makarov, M.S. 1977. (In Russian).

From Regional scientific-technical seminar; Groznyj, USSR (18 May 1977).

Considered are the theoretical bases of the radon tracer technique logging which requires gamma logging observations of in-well behaviour of radon-222 natural radioactive element (radium emanation) dissolved at the start of study in the definite amount of non-volatile liquid. It is proved that the radon tracer technique greatly facilitates solution of a wide range of problems encountered while drilling, developing and exploiting wells. Prospects for application of the radon tracer technique are based on high radiochemical purity of radon solutions used which practically are not adsorbed by logging and drilling equipment, clay crust, rock structure and so on.

EXPLOSIONS AND EXPLOSIVES

REFER ALSO TO CITATION(S) 6268

CHEMICAL

REFER ALSO TO CITATION(S) 6058

6136 (LA—7897-MS) **All secondary explosive hot-wire devices.** Dinegar, R.H.; Varley, D.T. III. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

The explosives PETN, HMX, HNS-1 and RDX can be ignited by a hot wire at low-current levels. When deflagrated under confinement, PETN and HMX generate sufficient gas pressures to actuate a valve or cutting mechanism. Under proper conditions, deflagrations in small charges of PETN or HMX will build up to detonation. Deflagrating charges can also be used to shear and accelerate a flying plate, which initates detonation in an acceptor explosive upon impact.

6137 (MHSMP—79-50) **Skid sensitivity of as-pressed PBX 9404.** Crutchmer, J.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1979. Contract EY-76-C-04-0487. 8p. Dep. NTIS, PC A02/MF A01.

The skid sensitivity of as-pressed PBX 9404 was determined. It was found that under certain conditions the as-pressed billets show a marked increase in sensitivity to skid impact compared to machined billets. A skid test series was also conducted on standard machined billets for comparison with previous data. A new critical height was established for the 14° drop angle (0.27 m compared to 0.38 m as previously reported).

6138 (MHSMP—79-51) **Development of process for producing fine particle size HNS I.** Stull, T.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1979. Contract EY-76-C-04-0487. 7p. Dep. NTIS, PC A02/MF A01.

A process was developed for producing fine particle size hexanitrostilbene (HNS) with a mean size of ~ 2 μm. The process involves dissolving HNS in dimethylformamide (DMF) and slowly adding this solution into a precooled, rapidly-agitated volume of distilled water. The resulting material is then filtered, washed with acetone/water and freeze-dried. The process yield is ~ 98% and provides a material with BET surface area results approaching 10 M^2/g.

6139 (MHSMP—79-52) **Joint TATB/D38 compatibility study.** Copeland, R.J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1979. Contract EY-76-C-04-0487. 10p. Dep. NTIS, PC A02/MF A01.

Coupon stacks consisting of TATB and D38 discs were sealed in stainless steel containers containing an argon atmosphere. The coupons were conditioned at 80°C with monthly gas samples and pressure measurements taken over a six-month period. Hydrogen was essentially the only gaseous product liberated from the TATB/D38 reactivity study. After a buildup of 1.4 cc-atm hydrogen during the first month of aging at 80°C, the hydrogen content remained essentially constant throughout the six-month aging period.

6140 (MHSMP—79-57) **Fluorescence x-ray analysis for chlorine in TATB.** Worley, R.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1979. Contract EY-76-C-04-0487. 5p. Dep. NTIS, PC A02/MF A01.

A method for analyzing chlorine in TATB is given. The method can detect chlorine concentrations in the range of a few parts per million to one percent.

6141 (SAND—79-1952) **Deflagration-to-Detonation Transition Project. Quarterly report, March 1979-May 1979.** Lieberman, M.L. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 82p. Dep. NTIS, PC A05/MF A01.

Processing studies performed on the MC3423 detonator include bridgewire welding, igniter loading, TIG welding, and stitch welding. Electrothermal response measurements have been included for control purposes. As the bridgewire location becomes further removed from the header surface, gamma and the no-fire level both decrease markedly. Consequently, processing now includes a controlled bridgewire height which yields reproducible and satisfactory gamma values. Feasibility has been shown for achieving a slower function time version of the MC3196 detonator by incorporating a $CP/B/CaCrO_4$ mixture in the igniter. Initial design of the MC3533 detonator (W86) has commenced.

6142 (SAND—79-2001C) **Thermal diffusivity of HNS high explosive.** Taylor, R.E.; Groot, H.; Donaldson, A.B. (Purdue Univ., Lafayette, IN (USA). Thermophysical Properties Research Center; Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 18p. (CONF-791134—2). Dep. NTIS, PC A02/MF A01.

From 16. international thermal conductivity conference; Chicago, IL, USA (7 Nov 1979).

The paper reports results of a study in which the variances of thermal diffusivity and conductivity of HNS high explosive with temperature, fabrication compaction pressure, sample source, and thermal cycling were measured. The technique used was a modified flash method in which the unknown sample is sandwiched between two layers of known properties with the appropriate analysis used for data reduction.

6143 (UCRL—82723) **Thermogravimetric study of TATB and two TATB-based explosives.** Garza, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1979. Contract W-7405-ENG-48. 14p. (CONF-791079—2). Dep. NTIS, PC A02/MF A01.

From 7. DOE compatibility meeting; Aiken, SC, USA (16 Oct 1979).

Basic physical properties of TATB (1,3,5-triamino, 2,4,6-trinitrobenzene) and TATB-based PBX's (plastic-bonded explosives) are needed, particularly to provide valid estimates of their long term thermal stability. Their thermal behavior in vacuum was studied by measuring the vapor pressures of TATB and two TATB-based PBX's. The equilibrium sublimation pressures and heats of sublimination of TATB and PBX's were determined in the temperature range of 150 to 200°C.

NUCLEAR

REFER ALSO TO CITATION(S) 6238

6144 (SAND—79-1864) **Response of a quick acting valve for underground nuclear blast containment.** Bennett, M.D.; Curry, W.H. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 37p. Dep. NTIS, PC A03/MF A01.

The motion of a large, sliding piston impelled by the action of an inert gas at high pressure is modeled mathematically by assuming that the working fluid behaves as an ideal gas and that a steady flow process prevails. It is found from numerical solutions of the governing equations that as the aperture, which connects the gas reservoir and receiver, is enlarged, a critical size is reached, beyond which the valve response remains essentially independent of any further increases in the aperture dimension. With supercritical apertures and

using, for example, 1.5 ft^3 of 15-kpsi nitrogen as the driver gas, the estimated time for a 2.6-ton piston to travel across a 6-ft wide tunnel is 31 milliseconds. Gases that have the largest number of molecular degrees of freedom theoretically impart the most motive power.

6145 (UCRL—52000-79-10, pp 25-27) **Fisheye camera for surveying NTS boreholes.** Oct 1979.

In Energy and technology review.

An improved camera for surveying borehole geological features at Nevada Test Site has been developed. This new camera incorporates a fisheye f1.9, 197-deg lens that can see straight down the hole while seeing a 360-deg panoramic view of the adjacent sidewalls. Pictures are taken automatically by depth-sensing circuitry, which takes images at preset distance intervals rather than at time intervals. A down-looking xenon tube-lamp and reflector assembly provides the lighting. The support framework incorporates features that maintain self-alignment within the hole and protect the camera from water condensate and debris. The unit is about 2 m long.

6146 **Numerical simulation of the Baneberry event.** Terhune, R.W.; Glenn, H.D.; Burton, D.E.; McKague, H.L.; Rambo, J.T. (Univ. of California, Livermore). *Nucl. Technol.;* **46**: No. 1, 159-169(Nov 1979).

On December 18, 1970, Baneberry, a 42-TJ (10-kt) nuclear device, was detonated at a depth of 278 m in hole U8d at the Nevada Test Site. A shock-induced fissure near ground zero opened and vented radioactive gases and debris into the atmosphere. Calculational results describe the sequence of dynamic phenomena that very likely produced the vent. The calculations predict the experimentally observed surface motion and long positive-velocity pulse. The surface fissure through which the material vented is approximately the same radial distance from ground zero as the maximum horizontal displacement is calculated to be. Also, the calculations indicate an explosive-induced extension of the Baneberry fault to the surface. This extension was observed in pictures of the surface motion and later confirmed by postshot on-site inspection. The final calculated cavity radius is very close to the measured Baneberry cavity radius. Finally, the calculations indicate that an open fracture path was generated that runs from the cavity to the Baneberry fault, up the fault to the spall region, and then vertically to the surface. This vent path predicted by the calculations is roughly consistent with the vent path found from the radioactivity in postshot drill holes. The extensions in computational capabilities in this work advance the state-of-the-art for numerical simulation of the containment aspects of underground nuclear tests.

WEAPONRY

REFER ALSO TO CITATION(S) 6163

6147 (UCRL—82499) **Statistical failure analysis of military systems for high-altitude EMP.** Cabayan, H.S.; Deadrick, F.J.; Martin, L.C.; Mensing, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Sep 1979. Contract W-7405-ENG-48. 8p. (CONF-790936—2). Dep. NTIS, PC A02/MF A01.

From Electrical overstress/electrostatis discharge symposium; Denver, CO, USA (25 Sep 1979).

A probabilistic approach to vulnerability assessment that allows inclusion of uncertainties into the analysis is outlined and discussed. The approach is illustrated and validated to a limited extent by two simple system experiments that included device failure data, circuit analyses, failure analyses, and separate laboratory system tests with a transient electromagnetic facility. The computer programs NET-2 and FAST were essential tools in the analyses.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

6148 (PB—293741) **A history of air pollution meteorology through 1969. Technical memo.** DeMarrais, G.A. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jan 1979. 84p. NTIS, PC AA05/MF A01.

A brief survey of the milestones in the history of air pollution meteorology is presented. Applied research investigations, basic research investigations and air pollution disasters and specialty groups are discussed. The appendix consists of an annotated bibliography - a chronological listing of 337 original works and events.

6149 (PB—294132) **Mauna Loa Observatory, a 20th anniversary report.** Miller, J. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Sep 1978. 167p. NTIS, PC AA08/MF A01.

During Mauna Loa Observatory's first twenty years scientists have been attempting to gain only the simplest comprehension of the processes and mechanisms of climatic change. This book records the history and drama of MLO's contribution to that effort. Following a brief history of the observatory, information is given on current understanding of the geology of Mauna Loa. Then geophysical measurements at Mauna Loa are discussed including gas measurements, aerosol measurements, solar measurements and meteorological measurements. Finally a pictorial history of Mauna Loa is given.

6150 **Mathematical model of drift deposition from a bifurcated cooling tower plume.** Chen, N.C.J.; Jung, L. (Oak Ridge National Lab., TN). *Atmos. Environ.;* **12**: 1969-1980(1978).

Cooling tower drift deposition modeling was extended by including the centrifugal force induced by plume bifurcation as a mechanism for droplet removal from the plume. The model is capable of predicting the trajectory of a single droplet from the stage of strong interaction with the vortex field soon after droplet emission at the tower top through the stage of droplet evaporation after breakaway from the plume. Applications showed the droplet to follow a helical trajectory within the plume, with breakaway and ground impact depending upon plume rise, ambient wind, evaporation, and vortex strength.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 5368, 5816, 6052, 6253

6151 (BM-RI—8374) **Citrate-process pilot-plant operation at the Bunker Hill Company.** Crocker, L.; Martin, D.A.; Nissen, W.I. (Bureau of Mines, Washington, DC (USA)). 1979. 77p. US Department of Interior, Bureau of Mines, Washington, DC.

A goal of the Federal Bureau of Mines is to minimize the undesirable environmental conflicts and impacts associated with mineral processing operations. To help reach this goal the Bureau operated a citrate-process pilot plant for the removal of sulfur dioxide from lead smelter sintering machine waste gases to test the process. The process uses a carboxylate solution such as citric acid to absorb sulfur dioxide from waste gases. The absorbed sulfur dioxide is subsequently reacted with hydrogen sulfide to precipitate sulfur and regenerate the solution for recycle. Nominal capacity of the pilot plant was 1,000 scfm of 0.5 vol-% sulfur dioxide gas. The pilot plant was operated for over 5400 hr and produced about 55 net tons of sulfur. The operation demonstrated that: (1) 99 % of the sulfur dioxide could be removed from lead smelter sintering machining waste gases containing from 0.1 to 0.6 vol-% sulfur dioxide; (2) sulfur precipitation and solution regeneration with hydrogen sulfide in conventional stirred vessels was readily controlled; (3) precipitated sulfur could be continuously recovered as a 99.5-%-pure product by flotation and melting; and (4) 78 dry-vol-% hydrogen sulfide gas could be produced from pilot-plant product sulfur, natural gas, and steam.

6152 (CONF-791089—1) **Chemical composition of cigarette smoke.** Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A02/MF A01.

From Toward a less hazardous cigarette meeting; Cold Spring Harbor, NY, USA (14 Oct 1979).

Cigarette smoke is a concentrated aerosol of liquid particles suspended in an atmosphere consisting mainly of nitrogen, oxygen, and carbon dioxide. While the precise chemical composition of the particulate and gaseous phases is dependent on the characteristics of the cigarette and the manner in which it is smoked, both phases contain tens of hundreds of individual constitutents. Notable among potentially hazardous constituents of smoke are tar, nicotine, carbon monoxide, nitric oxide, hydrogen cyanide, acrolein, benzo(a)pyrene, and N-nitrosamines.

6153 (COO—1199-59) **Urban influence on deposition of sulfate and soluble metals in summer rains.** Gatz, D.F. (Illinois State Water Survey, Urbana (USA)). 1979. Contract EY-76-S-02-1199. 33p. (CONF-791090—1). Dep. NTIS, PC A03/MF A01.

From Symposium on potential environmental and health effects of atmospheric sulfur deposition; Gatlinburg, TN, USA (14 Oct 1979).

Recent observations of abnormally acidic precipitation have raised questions regarding the distribution of acidic precipitation, its time trend, its sources of acidity, and the relevant physical and chemical processes involved in its formation. An attempt was made to answer some of these questions based on the content of sulfate and other materials in the atmosphere and in samples of summer convective rainfall from mesoscale sampling networks near St. Louis. These and other observations in the literature agree that rainfall deposits locally emitted sulfur at short distances downwind of cities. This causes enhanced deposition and concentration of sulfur in local rainfall and increases the local variability of these parameters relative to that of rain and crustally-derived materials, on both daily and

seasonal scales. Airborne sulfate concentrations vary by a factor of at least 2 to 4 from urban to rural areas on individual days. This is similar to the observed variation of sulfate deposition or concentrations in rain. Thus, there may be no need to invoke extensive SO_2 scavenging in rain systems to explain the observed enhancements; nucleation scavenging of atmospheric sulfate appears adequate.

6154 (LA-UR—79-3250) **Plume blight visibility modeling with a simulated photograph technique.** Williams, M.D.; Treiman, E.; Wecksung, M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 17p. (CONF-791139—2). Dep. NTIS, PC A02/MF A01.

From ACPA conference on visibility; Denver, CO, USA (26 Nov 1979).

A description is given of a visibility model and the results of its application to plume blight problems. The model calculates pollutant dispersion, atmospheric chemistry, and radiative transfer in plumes from industrial facilities. The principal model output is in the form of a simulated photograph that depicts a scene that has been modified by light scattering particulates and light absorbing gases. Pollutant dispersion is described by a gaussian model with provision for multiple reflections between the ground and an elevated stable layer. The atmospheric chemistry module is a photochemical oxidant code, which includes a carbon bond model, SO_2 chemistry, gas to particle conversion and particle growth and formation. Radiative transfer is treated with a multilayer iterative solution technique. The procedure involves collection of a clean picture of the scene that will be altered by an industrial plume. The information on the film is then extracted by a microdensitometer using fiters appropriate to the colors blue, green, and red. The resulting digital data is modified in accordance with the results of the radiative transfer calculations and written onto film. Either slide film or color print film may be used. The model has been applied in a number of cases. Selected examples that illustrate the importance of various visibility related parameters are presented.

6155 (NTIS/PS—79/0036) **Diesel exhaust emissions. Volume 1. 1964-1976 (citations from the NTIS data base). Report for 1964-1976.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1979. 205p. NTIS PC N01/MF N01.

This bibliography of Federally-funded research discusses aspects of exhaust gases from stationary and vehicular diesel engines. The citations include their pollution potential, composition, control, and formation procession combustion reactions. The effects of achieving better fuel consumption on the types of exhaust gases are covered. Research concerned with health effects of these exhaust gases is included. (This updated bibliography contains 199 abstracts, none of which are new entries to the previous edition.)

6156 (PB—289622) **Evaluation of emission control strategies for airfield operations at the Los Angeles and San Francisco International Airports. Final report.** Gelinas, C.G. (AeroVironment, Inc., Pasadena, CA (USA)). Aug 1978. Contract ARB-A7-077-30. 110p. NTIS PC A06/MF A01.

This report reviews potential air pollutant emission reductions which could be achieved by various strategies to control airfield operations at Los Angeles and San Francisco International Airports, and examines safety problems, cost impacts, potential fuel savings, time frame for strategy implementation, and potential regulatory and jurisdictional conflicts associated with each strategy. Airfield emission sources studied included aircraft operation in the idle, taxi, takeoff, and landing modes; ground service vehicles; fuel handling and storage; and aircraft engine maintenance. Nineteen potential strategies were identified, and seven strategies were selected for detailed analysis and examination after a preliminary evaluation. Two strategies, aircraft towing and reducing the number of operating engines on the ground, appear to provide the most significant emission reduction. Both of these strategies offer potential reductions in the range of 20 to 40 percent of the carbon monoxide and nitrogen oxides which are currently emitted by ground operations. The aircraft towing strategy also offers a comparable improvement in suspended particulate matter emissions. When the overall feasibility of each strategy is evaluated, the strategy to reduce the number of operating engines appears to be the most viable since its implementation would result in fuel savings, no apparent safety problems, and it can be implemented immediately.

6157 (PB—290388) **Iowa air quality report, 1977.** (Iowa Dept. of Environmental Quality, Des Moines (USA). Air Quality Management Div.). Apr 1978. 93p. NTIS PC A05/MF A01.

Iowa's air monitoring data from 1957 to 1977 has been compiled in this report for six pollutants monitored in the State: suspended particulates, sulfur dioxide, nitrogen dioxide, carbon monoxide, hydrocarbons and photochemical oxidants. The data are presented in tabular form for each of the twelve Air Quality Control Regions in the State. Additional sections discussing the pollutants and pollutant sources, the air monitoring network, and the analysis of data and trends have been added. A summary of suspended particulate levels from winter storms in Iowa is included.

6158 (PB—292817) **Optimum meteorological and air pollution sampling network selection in urban areas. Phase II. Test and evaluation. Semi-annual progress report no. 2.** Vukovich, F.M. (Research Triangle Inst., Durham, NC (USA)). Dec 1975. 30p. EDB.

This report describes work accomplished in the first year of phase 2 of a project on optimum meteorological and air pollution sampling network selection in urban areas. The development of a theory and formulation of models to yield an optimum meteorological and air pollution sampling network for St. Louis, Missouri is described in limited detail. Although the theory and models can be applied to any city, St. Louis was chosen for testing purposes because considerable amounts of wind and air pollution data collected in that vicinity during a regional study were made available for comparative analysis. During the first year of Phase 2, the first of two field programs was conducted. A description of this program and the results to date are presented. Illustrations include photographs of air pollution testing stations throughout the St. Louis area, maps showing the locations, names and numbers of stations maintained by the Research Triangle Institute, and overlaps with the Regional Air Pollution Study stations and city/county stations in the optimum sampling network.

6159 (PNL-RAP—37) **Development of a national interregional transport matrix for respirable particulates.** Eadie, W.J.; Davis, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 45p. Dep. NTIS, PC A03/MF A01.

The Pacific Northwest Laboratory (PNL) long-range transport model was used to produce monthly, average air concentrations of respirable particulates produced by 86 unit emission sources located at points on a grid spanning the continental United States. These monthly assessments were interpolated to provide monthly, average air concentrations resulting from a unit source located at the centroid of each of 238 Air Quality Control Regions (AQCR). The air concentration field from each emitter AQCR was averaged over each receptor AQCR to produce a population-weighted, average air concentration of respirable particulates. The final product is a matrix of the monthly, average air concentration of respirable particulates over each receptor AQCR resulting from the unit emission from each emitter AQCR. Matrices were generated using meteorological data from the months of January, April, July, and October 1974. The program was undertaken to develop a useful method of assessing the air quality impacts resulting from various predicted energy-technology use scenarios. The AQCR-to-AQCR matrix can be used with any siting scenario of energy technologies to predict the air quality impact on any AQCR of the projected emissions from other AQCRs by multiplying the matrix elements by the projected emissions and summing the products over the emitting AQCRs. The matrix approach will allow the ranking of the air quality impacts of various siting scenarios of energy technology use without rerunning the long-range transport model.

6160 (RLO—2227-727-7) **Theoretical analysis of perturbation solutions to the problem of inertial capture of aerosol particles.** Yoon, S.C. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Jul 1979. Contract EY-76-S-06-2227-027. 34p. Dep. NTIS, PC A03/MF A01.

Perturbation solutions are sought to the problem of inertial capture of aerosol particles. An exact solution is obtained for the particle velocity along the axis of symmetry. The exact solution suggests that the perturbation solution is extremely accurate for all Stokes numbers except those very near the critical Stokes number. Also, under certain boundary conditions, the exact solution shows that inertial capture can occur even for particles with Stokes numbers less than the critical Stokes number. A computer extension technique is examined for the analysis and improvement of the perturbation series.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6236, 6241, 6243

6161 (NUREG/CR—0717) **Dynamic model of the global iodine cycle for the estimation of dose to the world population from releases of iodine-129 to the environment.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 112p. (ORNL/NUREG—59). Dep. NTIS, PC A06/MF A01.

A dynamic linear compartment model of the global iodine cycle has been developed for the purpose of estimating long-term doses and dose commitments to the world population from releases of ^{129}I to the environment. The environmental compartments assumed in the model comprise the atmosphere, hydrosphere, lithosphere, and terrestrial biosphere. The global transport of iodine is described by means of time-invariant fractional transfer rates between the environmental compartments. The fractional transfer rates for ^{129}I are determined primarily from available data on compart-

ment inventories and fluxes for naturally occurring stable iodine and from data on the global hydrologic cycle. The dose to the world population is estimated from the calculated compartment inventories of ^{129}I, the known compartment inventories of stable iodine, a pathway analysis of the intake of iodine by a reference individual, dose conversion factors for inhalation and ingestion, and an estimate of the world population. For an assumed constant population of 12.21 billion beyond the year 2075, the estimated population dose commitment is 2×10^5 man-rem/Ci. The sensitivity of the calculated doses to variations in some of the parameters in the model for the global iodine cycle is investigated. A computer code written to calculate global compartment inventories and dose rates and population doses is described and documented.

6162 (UCRL—52000-79-5, pp ii-iii) **ARAC advises on reactor incident at Three Mile Island plant.** May 1979.

In Energy and Technology Review.

The LLL Atmospheric Release Advisory Capability (ARAC) center provided regular reports and projections on the movement of radioactive materials released into the atmosphere in the accident at the Three Mile Island nuclear plant in Pennsylvania. At the height of the crisis, from March 28 to April 5, ARAC issued advisory reports hourly from 4 a.m. to 4 p.m. (PST) every day and collected data the other 12 hours. When the problems became less acute, the reporting intervals were extended to four hours. Data in these reports were essential to contingency planning for greater releases of radioactivity than actually occurred. They were also used by airborne sampling teams to plan each sampling flight. A typical projection of the dispersal of a unit rate release of radioactivity from the plant is shown. The data are also displayed and distributed as contour plots to give quantitative assessments of the potential air concentrations. In the case of actual releases, air-sampling monitors, both airborne and ground-based, provided data to help verify the predictions and estimate source strengths. With few exceptions, there was excellent agreement between the predicted and measured movement of radioactivity.

6163 (UCRL—824484) **Self-induced rainout from a nuclear weapon.** Molenkamp, C.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jun 1979. Contract W-7405-ENG-48. 3p. (CONF-791030—1). Dep. NTIS, PC A03/MF A01.

From 7. conference on inadvertent and planned weather modification; Banff, Alberta, Canada (8 Oct 1979).

The conclusions we have reached are that rainout of fresh radioactive debris occurred at Hiroshima and Nagasaki, that this precipitation was initiated either by the weapon itself or by the ensuing fires or by both, and that self-induced rainout can occur and deposit sufficient amounts of radioactivity on the ground to pose a significant collateral damage hazard.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 5468

6164 **Optimal siting of energy facilities for minimum air pollutant exposure on a regional scale.** Emanuel, W.R. (Oak Ridge National Lab., TN); Murphy, B.D.; Huff, D.D. *J. Environ. Manage.;* No. 7, 147-155(1978).

A methodology for regional scale siting of energy facilities is presented. An optimization model in the form of a linear program allows the assignment of activity levels (e.g. generating capacity) to a set of candidate sites to minimize the exposure of population or critical categories of land use to air-dispersed pollutants. The assignment of activity levels is constrained by the suitability of each site. For energy facilities, water availability is frequently the limiting factor in site suitability. The optimization procedure is further constrained by the demand for increased capacity. The relationship between the minimization of exposure to air pollutants and other planning criteria is examined by invoking a multiple objective optimization concept. The sensitivity of the exposure index for air pollutants to changes in a cost objective function (minimum capital and operating cost) is given in terms of a constraint on cost increases beyond an independently optimal cost.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

6165 (DOE/SR/10018—3) **Evaluation of Douglas Point mark-capture data.** White, G.C. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract AS09-79SR10018. 16p. Dep. NTIS, PC A02/MF A01.

The mark-recapture data collected by Charles County Community College personnel were evaluated relative to population estimation. The data are generally inadequate to achieve reasonable estimates from the methods described by Otis et al. (1978), because too few individuals were captured during the individual trapping sessions due to the low density of small mammals. However, the number of individuals captured during each trapping session can still be used to monitor potential environmental impacts. A field experiment to evaluate the monitoring techniques is suggested.

6166 (PNL—2713) **Shrub-inhabiting insects of the 200 Area Plateau, southcentral Washington.** Rogers, L.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 55p. Dep. NTIS, PC A04/MF A01.

This study characterizes the insects (including spiders) associated with major shrubs of the 200 Area Plateau on the Hanford Site in southcentral Washington. Big sagebrush (Artemisia tridentata), rabbitbrush (Chrysothamnus sp.) and hopsage (Grayia spinosa) were the three shrubs included in the study. Hemiptera (true bugs) and homoptera (bugs) were the two groups most abundant on sagebrush. Homoptera and Araneida (spiders) were the common inhabitants of rabbitbrush, and Orthoptera (grasshoppers), Coleoptera (beetles), and Araneida the taxa most frequently collected from hopsage. A discussion of the effects of insects on western native shrubs is included. None of the insect populations appeared to threaten the stability of shrub stands, which is important because of the erodability of 200 Area soils.

6167 (RLO—2229-T3) **Industrial development in Alaska and its effects on the nutritional and physiological status of arctic animals. Reindeer research, 1967-1978. Terminal report.** Luick, J.R. (Alaska Univ., Fairbanks (USA). Inst. of Arctic Biology). Jun 1979. Contract EY-76-S-06-2229-003. 151p. Dep. NTIS, PC A08/MF A01.

Research activities from 1967 to 1978 are reviewed, and publications resulting from the research listed. Previously unpublished results are included. They are entitled: winter prey selection and consumption by the Alaskan wolf; body composition of the semidomesticated reindeer; use of indicator muscles and bones to estimate carcass weight and composition of reindeer; effect of physical form on the acceptability of alfalfa hay for reindeer; preferences of reindeer for three cereal grains; preferences of reindeer for five concentrate meals; the effect of added urea on the acceptability of livestock rations for reindeer; the effect of added Alaska seafood meals (shrimp, salmon, herring, and halibut) on the acceptability of a livestock ration for reindeer; the influence of nutrition and ambient temperature on water flux of reindeer; on the efficacy of urea for reindeer in ameliorating the stress of undernutrition for reindeer during winter; agronomic, plant ecology, and range management studies with perennial grasses proposed for use in revegetating disturbed rangelands along Alaska's transportation corridor; and, seasonal changes in grazing preferences of reindeer for six grasses proposed for use in revegetating transportation corridors in Alaska. (JGB)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6174

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 5450, 6163

SOIL

REFER ALSO TO CITATION(S) 5449, 5453, 5457

6168 (EGG—1183-1722) **Aerial radiological survey of the US Department of Energy's Mound Facility, Miamisburg, Ohio.** (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Mar 1978. Contract EY-76-C-08-1183. 15p. Dep. NTIS, PC A02/MF A01.

An aerial radiological survey to measure terrestrial gamma radiation was carried out by helicopter over an area centered on Mound Facility, a 180 acre area adjacent to the southern edge of the city of Miamisburg, Ohio. This survey was part of an effort to document background radiation levels around nuclear processing and handling facilities owned or contracted by the United States Department of Energy (DOE). Survey activities were conducted and performed by EG & G for the DOE. Wright-Patterson Air Force Base served as the survey base of operations. During the survey, gamma ray data were collected over a 12.3 km^2 area by

flying an east-west grid of lines spaced 61 m apart, flying slowly over several selected areas, and hovering over several spots of interest. The processed data indicated that the on-site radioactivity was primarily due to radionuclides currently being handled or processed at the Facility, and that lesser activity could be attributed to previously handled or processed nuclear materials. Off-site data showed the radioactivity to be that only due to naturally occurring radionuclides.

6169 (LA-UR—79-3275) **LASL experience in decontamination of the environment.** Ahlquist, A.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 11p. Dep. NTIS, PC A02/MF A01.

Since 1972 the Los Alamos Scientific Laboratory (LASL) has been actively involved in land area surveys for radioactive contamination and has gained considerable experience in cleanup of lands considered to have unacceptable levels of radioactive contamination. Experience and means of arriving at recommendations for decontamination at levels as low as reasonably achievable.

6170 (NUREG/CR—1155) **Interactions of radioactive wastes with soils. A review, October 1976-May 1979.** Fowler, E.B.; Essington, E.H.; Polzer, W.L. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 42p. (LA-UR—79-2910). Dep. NTIS, PC A03/MF A01.

Retention of waste radionuclides by four soils of different types was determined using the batch and column methods. Raw and treated liquid wastes from a large laboratory complex were used. Three fractions identified in each waste were (1) insoluble, (2) soluble and sorbable by soil, and (3) soluble but nonsorbable by soil. The soluble fraction (< 0.05 μm) in raw and treated wastes increased with storage time but the increase did not directly relate to the amount retained by the soil. The degree of retention of each radionuclide is influenced by both soil type and waste composition. Ninety-five to one hundred percent of raw waste ^{137}Cs was retained by all soils. Plutonium isotopes and ^{241}Am were least retained by the soils; uranium isotope retention was intermediate. Reaction of a Fuquay soil with the insoluble fraction of the waste resulted in a net dissolution of Pu and Am. Two of the factors investigated that could influence the degree of retention by the soil were (1) charge on the radionuclide in solution, and (2) degree of calcium carbonate saturation. Retention of radionuclides by the soils occurs through ion exchange, occlusion in calcium carbonate precipitates, precipitation of aluminum, and filtration of particulates from the liquid wastes.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 6161, 6238, 6241, 6244

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 6166, 6184

6171 (EPRI-ER—1070(Vol.3)) **Environmental assessment methodology: solar power plant applications. Volume 3. Environmental impact assessment application. Final report.** Nair, K.; Sicherman, A. (Woodward-Clyde Consultants, San Francisco, CA (USA)). May 1979. 112p. Dep. NTIS, PC A06/MF A01.

In Volume II of the four-volume series the environmental impact assessment methodology described in Volume I is applied to a problem of site selection for solar-thermal power plants. Environmental impact assessments of selected solar-thermal sites are compared. Certain potential impacts of solar-thermal and wind energy central systems are examined. In appendix A a data base system that was used to organize the literature on selected data base sites is described. Appendix B contains detailed calculations and preliminary data used in the environmental impact assessment. Appendix C presents a discussion of generic attributes for measuring biological impacts. Appendix D is a selected bibliography of general references dealing with environmental impacts of solar-thermal and wind energy central systems.

6172 (EPRI-ER—1070(Vol.4)) **Environmental assessment methodology: solar power plant applications. Volume 4. Decision analysis computer program. Final report.** Nair, K.; Sicherman, A. (Woodward-Clyde Consultants, San Francisco, CA (USA)). May 1979. 50p. Dep. NTIS, PC A03/MF A01.

The purpose of the computer program described in Volume 4 of the four-volume series is to facilitate the implementation of the decision analysis approach to multiobjective decision-making problems in regard to the environmental impact assessment of solar power plants. The capabilities of the computer program are described, and examples that will show how to use it effectively are given. Notation and general concepts are explained. The basic commands and other useful commands are described. Examples showing the variety of problems for which the program is applicable are given. A user's summary of the available commands is provided in Appendix A. Computer interface requirements for implementing the program on any particular system and the basic program structure with respect to coding are discussed in Appendix B.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 5541

6173 **Fish in studies of aging.** Woodhead, A.D. (Brookheaven National Lab., Upton, NY). *Exp. Gerontol.;* 13: 125-140(1978).

Information obtained from studies of wild fish was assembled which illustrated the flexibility of growth and reproductive responses to environmental changes. Emphasis was given to the effects of food availability and space restriction, since these factors have been manipulated in laboratory studies and might be profitably used again. The use of fish as experimental animals in aging and growth was discussed.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 5319, 5392, 5394, 6181, 6182, 6183, 6252, 6254

6174 (COO—2727-7) **Contamination of groundwater by heavy metals from the land disposal of fly ash. Final report.** Theis, T.L. (Notre Dame Univ., IN (USA). Dept. of Civil Engineering). Sep 1979. Contract EY-76-S-02-2727. 82p. Dep. NTIS, PC A05/MF A01.

Information is provided on laboratory and field research to assess the aquatic effects and extent of release, migration, and attenuation of trace metals from fly ash into subsurface soil environments for a typical disposal regime. Those metals analyzed were arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Laboratory studies indicated that the major effects of fly ash in water were pH alterations, which could be either acidic or basic, and comparatively high proportions of trace metals released from the ash surface, controlled largely by pH. Field studies confirmed the continued importance of pH in defining the attenuation of the metals by the soil but also suggested that pSO_4, ionic strength, and soil chemical parameters, such as iron and manganese content, could not be ignored. Theoretical thermodynamic analysis in concert with field data indicated that both adsorption onto soil phases and precipitation of metal phases occurred, the dominant attenuation mechanism depending upon the specific metal and soil conditions.

6175 (DOE/ER/70025—27) **Pollutant transport and sediment dispersal in the Washington-Oregon Coastal Zone. Report of progress, October 1978 through September 1979.** Hickey, B.M. (comp.). (Washington Univ., Seattle (USA). Dept. of Oceanography). 1979. Contract EY-76-S-06-2225-025. 86p. (RLO—2225-TA25-27). Dep. NTIS, PC A05/MF A01.

Progress is reported in work performed in the program that seeks to provide tested predictive models for the transport of dissolved and particulate matter in coastal regions. Modeling efforts in coastal circulation, boundary layer mechanics, sediment transport, and animal-sediment interactions are underway. The program is restricted to measurements of flow outside the logarithmic boundary layer. These measurements provide the information necessary to allow modeling of the flow and the transport of sediment in the benthic boundary layer. Transmissometer and current meter measurements were made at several near-bottom locations in the vicinity of Quinault Canyon. Results of a study on the effects of a narrow submarine canyon (Astoria) on low-frequency shelf circulation are reported. Two components of the sediment-animal-flow interaction triad were studied. They are: the effects of organisms on sediment characteristics and the effects of the activities of the benthic organisms on the near wall flow characteristics. Progress is also reported in the development of a bed load transport equation. (JGB)

6176 (INKA-CONF—79-187-002) **Synthesis and testing of chelating ion exchangers to remove heavy metal ions from water.** Grote, M.; Kettrup, A. (Gesamthochschule Paderborn (Germany, F.R.). Fachbereich Chemie und Chemietechnik). 1979. 8p. (In German). (CONF-7905119—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Annual meeting of the task group on water chemistry of the Gesellschaft Deutscher Chemiker; Bad Pyrmont, F.R. Germany (21 May 1979).

Substituted formazans were fixed on cellulose, amino-, and chloromethylated polystyrene. The chelating ion exchangers show great affinity to platin metals, but no affinity to nonferrous metals. The recovery of noble metals from waste waters of galvanizing plants seems to be possible.

6177 (LBL—9831) **Application of Zeeman Atomic Absorption Spectroscopy for measurement of cadmium in wheat.** Branstetter, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

Calibration and use of the Zeeman Atomic Absorption (ZAA) system to measure Cd are discussed. The results of measurements of NBS Standard Reference Material (SRM) 1571, Orchard Leaves comparing the ZAA and NBS results are tabulated. A second run shows the results of both SRM 1571 and pulverized wheat. In a third experiment the husk or hull of the pulverized wheat was analyzed separately from the pulp or interior. The values resulting from both measurements indicate that Cd concentrations may selectively migrate to the hard husk as opposed to the wheat pulp. These results are preliminary and further testing should be conducted on several varieties of wheat to determine whether the same is true of all wheat varieties. The implications of this finding could be far reaching with respect to wheat bran and comestibles utilizing wheat bran. (JGB)

6178 (PB—289392) **Computer model for predicting pollution in the Missouri River. Completion report, 1 October 1977-30 September 1978.** Liu, H.; Cheng, H. (Missouri Univ., Columbia (USA). Dept. of Civil Engineering). 15 Nov 1978. Contract DI-14-34-0001-8027. 105p. NTIS PC A06/MF A01.

Whenever there is an accidental spill of hazardous chemicals or radioactive materials into any river, it is vitally important to be able to issue an immediate forecast of the arrival time and peak concentration of a pollutant at each downstream city, to enable water users downstream to take effective precaution measures. Adequate forecast of this type was not possible in the past because of the lack of a proper model to predict one-dimensional dispersion in natural streams. This study resulted in the development of an improved model. The new model is a modified Fickian model which uses a time-dependent dispersion coefficient, a time-scale much greater than the Fischer time-scale, and a Pearson-Type-III distribution of concentration.

6179 (PNL-SA—7952) **Overview of US research activities in the dispersion of dense gases.** McNaughton, D.J.; Berkowitz, C.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. Contract EY-76-C-06-1830. 41p. (CONF-790993—1). Dep. NTIS, PC A03/MF A01.

From Symposium on dense gas; Frankfurt, F.R. Germany (3 Sep 1979).

Progress is reported in the understanding of dense gas dispersion through application of theory from other disciplines and preliminary experimentation particularly in the area of LNG. Future efforts should be directed to providing generalizations that can be expanded to all hazardous dense gases and to reducing uncertainties in dense gas models. Specific suggestions are made for research applicable to dense gas dispersion.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6254

WATER

REFER ALSO TO CITATION(S) 5457, 5463, 6178, 6243

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 6161, 6238, 6241

6180 (COO—3563-70) **Bacteria and plutonium in marine environments.** Carey, A.E.; Bowen, V.T. (Woods Hole Oceanographic Institution, MA (USA)). 1978. Contract EY-76-C-02-3563. 13p. (CONF-7805193—1). Dep. NTIS, PC A02/MF A01.

From American Society for Microbiology annual meeting; Las Vegas, NV, USA (May 1978).

Microbes are important in geochemical cycling of many elements. Recent reports emphasize biogenous particulates and bacterial exometabolites as controlling oceanic distribution of plutonium. Bacteria perform oxidation/reduction reactions on metals such as mercury, nickel, lead, copper, and cadmium. Redox transformations or uptake of Pu by marine bacteria may well proceed by similar mechanisms. Profiles of water samples and sediment cores were obtained along the continental shelf off Nova Scotia and in the Gulf of St. Lawrence. Profiles of water samples, and sediment cores were obtained. Epifluorescent microscopy was used to view bacteria (from water or sediment) after concentration on membrane filters and staining with acridine orange. Radiochemical analyses measured Pu in sediments and water samples. Studies of ^{237}Pu uptake used a strain of Leucothrix mucor isolated from a macroalga. Enumeration shows bacteria to range 10^4 to 10^5 cells/ml in seawater or 10^7 to 10^8 cells/gram of sediment. These numbers are related to the levels and distrbution of Pu in the samples. In cultures of L. mucor amended with Pu atom concentrations approximating those present in open ocean environments, bacterial cells concentrated ^{237}Pu slower and to lower levels than did clay minerals, glass beads, or phytoplankton. These data further clarify the role of marine bacteria in Pu biogeochemistry.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 6245

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 5288, 5817

6181 (PB—289874) **Environmental effects of oil shale mining and processing. Part 1. Fishes of Piceance Creek, Colorado, prior to oil shale processing. Final report.** Goettl, J.P. Jr; Edde, J.W. (Colorado Div. of Wildlife, Fort Collins (USA). Fisheries Research Center). Oct 1978. 29p. NTIS PC A03/MF A01.

The fish populations of Piceance Creek, Colorado, were surveyed to establish preoperational conditions prior to extensive oil shale processing in the region. Data collected in this study have been compared to data reported by earlier researchers. The mountain sucker (Catostomus platyrhynchus) and the speckled dace (Rhinichthys osculus) are the most abundant and widespread fishes found in Piceance Creek. Numbers of all species were not great; the largest number of fish captured per 100 meters of stream was 76 individuals, while the range for all other stations was 3-23 fish/100 m. Brook, brown, and rainbow trout (Salvelinus fontinalis, Salmo trutta, and Salmo gairdneri, respectively) were most common in the upper reaches of Piceance Creek and in its tributaries, Black Sulfur Creek and Stewart Creek. Results of the survey indicate that brook and brown trout are reproducing naturally in Piceance Creek but rainbow trout are doing poorly. Possible impacts of oil shale processing on the fish populations of Piceance Creek are suggested.

6182 (PB—289882) **Environmental effects of western coal combustion. Part 1. The fishes of Rosebud Creek, Montana. Final report.** Elser, A.A.; Schreiber, J.C. (Colorado State Univ., Fort Collins (USA). Natural Resources Ecology Lab.). Nov 1978. 46p. NTIS PC A03/MF A01.

Fish populations have been studied during 1975 and 1976 in Rosebud Creek, a prairie stream which flows through the Fort Union Coal Basin in southeastern Montana. The objective of this study was to collect fish population data to determine any immediate effects, and to act as a yardstick for assessing possible future effects of accelerated activities of coal mining and coal combustion in this region. Fishes were inventoried at nine stations and included 21 species representing nine families. The species composition and fish distribution were representative of other streams in this region. Game fishes included northern pike found throughout the stream, brook trout which occurred in the headwater areas, and sauger, walleye, channel catfish, and turbot which were found near the confluence with the Yellowstone River. The most abundant nongame species were white sucker and shorthead redhorse. There was no apparent effect of either coal mining or coal combustion activities on the distribution of fishes in Rosebud Creek.

6183 (PB—291251) **Environmental effects of oil shale mining and processing. Part 2: The aquatic macroinvertebrates of the Piceance Basin, Colorado, prior to oil shale processing. Final report.** Gray, L.J.; Ward, J.V. (Colorado State Univ., Fort Collins (USA). Natural Resources Ecology Lab.). Oct 1978. 50p. NTIS PC A03/MF A01.

A study was conducted at sampling sites on four streams in the Piceance Basin of northwestern Colorado to acquire data on benthic macroinvertebrate communities prior to commencement of oil shale mining and processing activities. Piceance Creek, the major stream studied, exhibited considerable longitudinal variation in environmental conditions. Sodium, sulfate, chloride, and total dissolved solids increased greatly in the downstream direction. The temperature range, turbidity, severity of winter ice conditions, and effects of grazing and irrigation activities also increased downstream. Downstream reductions in density, biomass and diversity, and altered macroinvertebrate species composition were associated with the longitudinal changes in environmental parameters. Effects of oil

shale mining and processing activities on aquatic biota will depend upon the type of mining employed, the extent of surface and subsurface disturbance, the success of pollution controls, points of pollution entry, and extent of water depletion. Present environmental conditions and macroinvertebrate communities of lower reaches of Piceance Creek may be indicative of the potential effect of future impacts at upstream locations.

REGULATIONS

REFER ALSO TO CITATION(S) 5817

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 6171, 6172

6184 (EPRI-ER—1070(Vol.1)) **Environmental assessment methodology: solar power plant applications. Volume 1. Environmental impact assessment methodology. Final report.** Nair, K.; Sicherman, A. (Woodward-Clyde Consultants, San Francisco, CA (USA)). May 1979. 161p. Dep. NTIS, PC A08/MF A01.

A methodology is described in Volume 1 of the four-volume series for environmental impact assessment of solar power stations based on decision analysis. A general overview of the methodology is presented, including a discussion of the issues warranting a formal analysis, the advantages of decision analysis from the decision maker's perspective, and some case study examples where the methodology was applied. A description is given of the step-by-step implementation procedure for performing an environmental impact assessment using the methodology. A simple example is used throughout this section to illustrate the procedure. The manner in which the methodology can incorporate cost into the analysis, both as a concern and as a yardstick of comparison, is discussed. Decision analysis and cost-benefit analysis are compared and contrasted. The appendix includes a bibliography concerning methods used by industry and/or government to make monetary estimates of environmental impacts.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 5488, 5494, 6171, 6172, 6184

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 5451

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

6185 **Stimulus properties of inhaled substances.** Wood, R.W. (Univ. of Rochester School of Medicine, NY). *Environ. Health Perspect.;* **26**: 69-76(Oct 1978).

Inhaled substances can modify behavior by their toxic action, or because they are discriminable events, or because they can support or suppress behavior. They can be used as discriminative stimuli at concentrations above the olfactory threshold. Inhalants can elicit unconditioned reflexes. As aversive stimuli, they can be studied in respondent conditioning experiments (e.g. conditioned suppression), in punishment paradigms, or as negative reinforcers in escape paradigms. Inhalants can also be positive reinforcers; their intoxication properties have engendered patterns of chronic self-administration (solvent abuse). Such stimulus properties should be considered in industrial hygiene and environmental quality decisions. Laboratory techniques to study such properties abound.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 6207, 6209, 6210, 6215, 6216

6186 **Time-resolved electron spin resonance study of the oxidation of ascorbic acid by hydroxyl radical.** Fessenden, R.W.; Verma, N.C. (Carnegie-Mellon Univ., Pittsburgh, PA). *Biophys. J.;* **24**: No. 1, 93-101(Oct 1978).

Time-resolved electron spin resonance (ESR) spectroscopy for the study of radicals produced by pulse radiolysis is illustrated by a study of the oxidation of ascorbic acid by OH radical in aqueous solution. In basic solution, the direct oxidation product, the ascorbate mono-anion radical, is formed within less than 2μs of the radiolysis pulse. In acid solutions (pH 3 to 4.5, N_2O:saturated) three radicals are initially formed, the ascorbate mono-anion radical, an OH adduct seen also in steady-state ESR experiments, and an OH adduct at C2 with the main spin density at C3 of the ring. The first OH adduct decays with an initial half-life of about 100 μs, probably by bimolecular reaction. The second OH adduct, which shows one hyperfine splitting with a/sup H/ = 24.4 +- 0.3 G and g = 2.0031 +- 0.0002, decays with a half-life of about 10 μs. On this same time scale the concentration of the ascorbate radical approximately doubles. It is concluded that the adduct at C2, but not the other adduct, loses water rapidly to form the ascorbate radical.

6187 (LBL—9105) **Third solar photochemistry research conference, June 19-22, 1979: abstracts.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 91p. (CONF-790681—(Absts.)). Dep. NTIS, PC A05/MF A01.

From 3. solar photochemistry research conference; Pacific Grove, CA, USA (19 Jun 1979).

Abstracts from the third solar energy research conference are presented. Topics covered are: theoretical studies of energy transfer; stereoelectronic properties of aggregated chlorophyll systems; extended Huckel calculations on porphyrins, chlorins and isobacteriochlorins; structural features of chlorophyll complexes in vitro and in vivo as determined by triplet state optically detected magnetic resonance; excited state properties of models for reaction center chlorophyll; singlet state charge transfer reactions in cofacial diporphyrins; the efficiency of photo-redox reactions in solution; photoprocesses in chlorophyll aggregates; multiphoton redox photochemistry; photosensitized redox reactions across vessicle membranes; photoinduced electon transfer across a water-oil boundary; physical and chemical studies of chlorophyll in microemulsions; light energy conversion by bacteriorhodopsin, time resolved resonance Raman and fluorescence studies of the photosynthetic proton pump system of bacteriorhodopsin; concentration quenching of chlorophyll fluorescence and the question of green plant antenna; mechanism of photochemical energy conversion by chlorophyll; electron spin echo spectroscopic studies of photo-reaction centers; primary events in green plant photosynthesis by time resolved EPR; a revipsed Z-scheme for plant photosynthesis; dye-sensitized photovoltaic cells; redox reactions at photoelectrodes prepared from photoreaction center models; photoelectro-chemical properties of metalloporphyrins.

6188 (LBL—9748) **I. Cyclopeptide alkaloids; II. Phycocyanobilipeptides.** Lagarias, J.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 135p. Dep. NTIS, PC A07/MF A01.

Several examples of the 14-membered, para-bridged ring system of the cyclopeptide alkaloids have been synthesized via an active ester cyclization. The yield of monomeric cyclopeptide varied from 1 to 33% and was affected by the amino acid substitution pattern and amide conformation of the linear peptide precursors. Both the synthetic models and a naturally cyclopeptide alkaloid, ceanothine B, bind monovalent (Li^+) and divalent (Ca^{++}, Mg^{++}) cations. Seven cyclopeptide alkaloids, phencyclopeptines 1-7, have been found distributed among three forms of the shrub Ceanothus integerrimus. Chemical degradation, mass spectroscopy, and ^1H NMR spectroscopy have established structures for these seven compounds, three of which have been previously reported. The utility of cyclopeptide alkaloid structure and the distribution for chemotaxonomic assignments is discussed. Field desorption mass spectroscopy has identified five phencyclopeptines in the crude alkaloidal extracts of Ceanothus sanguineus. A new paired-ion HPLC system for the separation of these alkaloids is discussed. Amino acid analysis, electron impact mass spectroscopy, and ^1H NMR spectroscopy have established the structures of six phencyclopeptines including two isomeric compounds 5 and 6. The structure of 2 has not been previously reported. The smallest cyanogen bromide fragment derived from the β-subunit of Synechococcus sp 6301 C-phycocyanin, the blue heptapeptide 2, has been investigated by 360 MHz ^1H NMR spectroscopy. The peptide portion, heptapeptide 3, was synthesized independently and used in comparative spectroscopic analysis.These studies have led to complete assignment of the structure of the

peptide-linked phycocyanobilin and elucidation of the nature of the thioether chromophore-peptide linkage.

6189 Origin of 25-hydroxyvitamin D_3 binding protein from tissue cytosol preparations. Kream, B.E.; DeLuca, H.F.; Moriarity, D.M.; Kendrick, N.C.; Ghazarian, J.G. (Univ. of Wisconsin, Madison). *Arch. Biochem. Biophys.;* **192**: No. 1, 318-323(1979).

The 6 S, cytosolic 25-hydroxyvitamin D_3 binding protein found in several rat tissues reacts with an antibody directed to the serum 25-hydroxyvitamin D_3 transport protein. The 6 S "cytosolic" protein is not found in carefully washed intestinal mucosal cells isolated from chicks and rats, but can be made to appear by adding serum to the cytosol itself or to the cells prior to homogenization. On the other hand, the rat intestinal 3.2 S cytosol binding protein for 1, 25-dihydroxyvitamin D_3 does not react with the antibody to the serum transport protein. Thus the 6 S, 25-hydroxyvitamin D_3 binding protein does not appear to be a physiologically significant substance, but rather the result of the serum 25-hydroxyvitamin D_3 transport protein interacting with a cytosolic protein in vitro.

6190 Flash spectroscopic studies of cyclic electron flow in intact chloroplasts. Slovacek, R.E.; Hind, G. (Brookhaven National Lab., Upton, NY). *Biochem. Biophys. Res. Commun.;* **84**: No. 4, 901-906(30 Oct 1978).

The kinetic behaviors of cytochrome b-563 and cytochrome f are shown to be consistent with their participation in coupled cyclic electron flow in intact chloroplasts. Electron transfer between cytochromes b-563 and cytochrome f is antimycin sensitive. Fluorescence induction studies indicate that plastoquinone may function in a coupled step between the cytochromes.

6191 Time-resolved resonance Raman characterization of the intermediates of bacteriorhodopsin. Terner, J.; El-Sayed, M.A. (Univ. of California, Los Angeles). *Biophys. J.;* **24**: No. 1, 262-264(Oct 1978).

In an attempt to determine eventually the structure of the chromophore of the intermediates involved in the primary process of the photosynthetic proton-pumping cycle of bacteriorhodopsin, new simple techniques have been developed (1 to 4) to obtain time-resolved resonance Raman spectra of this system. The techniques used in this report involve chopping continuous wave (CW) laser light to produce pulses of variable width and separation to obtain temporal information on the microsecond and millisecond time scales. An optical multichannel analyzer (Princeton Applied Research Corp., Princeton, NJ) with a Dry Ice-cooled silicon-intensified vidicon is used for detection. By using these techniques as well as different laser frequencies to take advantage of differing resonance enhancements of the intermediates, flow techniques (5 to 7), and computer subtraction methods, the resonance Raman spectra of the retinal chromophore of the individual intermediates are extracted.

6192 Picosecond pulse train study of exciton dynamics in photosynthetic membranes. Geacintov, N.E. (New York Univ., New York); Swenberg, C.E.; Campillo, A.J.; Hyer, R.C.; Shapiro, S.L.; Winn, K.R. *Biophys. J.;* **24**: No. 1, 347-359(Oct 1978).

The fluorescence decay time of spinach chloroplasts at 77°K was determined at 735 nm (corresponding to the photosystem I emission) using a train of 10-ps laser pulses spaced 10 ns apart. The fluorescence lifetime is constant at $\sim$ 1.5 ns for up to the fourth pulse, but then decreases with increasing pulse number within the pulse train. This quenching is attributed to triplet excited states, and it is concluded that triplet excitons exhibit a time lag of about 50 ns in diffusing from light harvesting antenna pigments to photosystem I pigments. The diffusion coefficient of triplet excitons is at least 300 to 400 times slower than the diffusion coefficient of singlet excitons in chloroplast membranes.

6193 Replication of poly dA and poly rA by a Drosophila DNA polymerase. Brakel, C.L.; Blumenthal, A.B. (Univ. of California, San Francisco). Contract AT(04-3)-1012-387. *Nucleic Acids Res.;* **5**: No. 7, 2565-2576(Jul 1978).

The activity of a 7.3S to 8.3S Drosophila DNA polymerase was characterized in detail using poly dA . p(dT)/sub anti 16/ and poly rA . p(dT)/sub anti 16/. With poly dA . p(dT)/sub anti 16, Mg^{2+} ion was the preferred divalent cation, and enzyme activity was inhibited by K^+ ion and by spermidine. With poly rA . p(dT)/sub anti 16/, Mn^{2+} ion was the preferred divalent cation and enzyme activity was stimulated by K^+ ion and by spermidine. The dependence of enzyme activity on the concentration of primer-template and on the ratio of primer to template was the same in both reactions. The two enzyme activities were identically inhibited by N-ethylmaleimide. Poly dA was replicated extensively and poly rA was replicated partially. The activation energy for poly dA replication was twice that for poly rA replication. Enzyme activity with poly dA . p(dT)/sub anti 16/ was more stable to thermal inactivation than was enzyme activity with poly rA . p(dT)/sub anti 16/. These studies suggest that the same enzyme responds to both the deoxy- and the ribohomopolymer template but that the mechanisms of replication may be different.

6194 Metabolic indicators of habitat condition and capture stress in pronghorns. Seal, U.S.; Hoskinson, R.L. (Univ. of Minnesota, St. Paul). *J. Wildl. Manage.;* **42**: No. 4, 755-763(1978).

Blood samples were collected from 3 Idaho pronghorn antelope (Antilocapra americana) populations whose summer ranges are separated by physiographic features. Hematology and blood chemistry data were analyzed in terms of stress, age, sex, and ecological features of the habitat. Capture effects were reflected in levels of lactic dehydrogenase (LDH), creatine phosphokinase (CPK), serum glutamic-oxalacetic transaminase (SGOT), and perhaps serum cortisol. Age differences were observed for hematology, fibrinogen, LDH, and SGOT. There were age and sex differences in alkaline phosphatase levels. Differences were found between populations with respect to 15 of the 19 assays performed. Effects attributable to differences in nutrition were observed for serum urea nitrogen, nonesterified fatty acids (NEFA), serum triglycerides, and alkaline phosphatase. Serum urea concentrations were related to the protein content of available food plants. The results indicate that it may be possible to assess the condition of pronghorn antelope habitat by measurement of the metabolic status of animals from free-ranging populations.

6195 Inhibition of ribonuclease: Efficacy of sodium dodecyl sulfate, diethyl pyrocarbonate, proteinase K and heparin using a sensitive ribonuclease assay. Mendelsohn, S.L.; Young, D.A. (Univ. of Rochester School of Medicine and Dentistry, NY). *Biochim. Biophys. Acta;* **519**: 461-473(1978).

The effectiveness of several commonly used inhibitors of ribonuclease (RNAase) has been studied using the removal of radiolabelled leucine from leucyl-tRNA as a sensitive assay for RNAase activity. The inhibitors were tested under a variety of conditions, varying the temperature, the pH, and the source of RNAase. When each inhibitor is used separately in the presence of pancreatic RNAase, sodium dodecyl sulfate (SDS) is the most effective; but during long exposures to temperatures above 0°C considerable amounts of RNA are still degraded. Combinations of inhibitors are more effective in preserving RNA; with this assay, a combination of SDS with diethyl pyrocarbonate is the most effective. Proteinase K acts as an inhibitor when used in combination with SDS; however, it has RNAase activity when used by itself. Diethyl pyrocarbonate, when used at the high range of concentrations employed by others for RNAase inhibition, reacts with RNA changing its charge. However, when diethyl pyrocarbonate is used in smaller amounts the effects on RNA are minimal, and when used in combinations with SDS it effectively inhibits RNAase.

6196 Indole alkaloids of Rauwolfia reflexa. The structures of rauflexine and reflexine. Chatterjee, A. (Univ. College of Science, Calcutta, India); Chakrabarty, M.; Ghosh, A.K.; Hagaman, E.W.; Wenkert, E. *Tetrahedron Lett.;* No. 40, 3879-3882(1978).

Recently the structure of 2 indole alkaloids isolated from the leaves of Rauwolfia reflexa was reported. One of these compounds, $C_{21}H_{24}N_2O_2$ was identified as the known alkaloid, purpeline based on its chemical conversion to mitoridine, as indicated by superimposable ir spectra. The second base, $C_{21}H_{26}N_2O_2$, a new alkaloid was designated, reflexine. In connection with continued structure analysis of the alkaloidal components of Rauwolfia species the ^{13}C-nuclear magnetic resonance spectra of several ajmaline-type bases were examined. This study reveals that the aromatic substitution pattern assigned to the indolic bases requires revision. The substance originally identified as purpeline is a new alkaloid now designated, rauflexine. A structural formula for rauflexine is presented.

6197 Conformational flexibility in DNA structure as revealed by structural studies of drug intercalation and its broader implications in understanding the organization of DNA in chromatin. Sobell, H.M.; Reddy, B.S.; Bhandary, K.K.; Jain, S.C.; Sakore, T.D.; Seshadri, T.P. (Univ. of Rochester, NY). *Cold Spring Harbor Symp. Quant. Biol.;* **42**: 87-102(1978).

This paper reviews evidence for conformational flexibility in DNA structure (i.e., the kink) as revealed by structural studies of drug intercalation. It then describes the implications these concepts have in understanding the organization of DNA in chromatin. It is possible that the kink has still broader meaning in understanding the nature of protein-DNA interactions that are important in RNA transcription and DNA replication.

6198 Mechanism of anterior-posterior polarity control in planarians. Lange, C.S.; Steele, V.E. (Univ. of Rochester, NY). *Differentiation;* **11**: 1-12(1978).

The substance which inhibits brain formation in the regenerating planarian Dugesia etrusca was found to be a large molecule, at least in part protein, which electrophoreses as an electronegative moiety in pH 6.8 buffer. A model is presented, based on this finding and previous studies, which proposes an electrochemical mechanism for the control of polarity and possibly for the maintenance of tissue organization in planarians. It is proposed that a bioelectric field exists and moves the electronegative brain-inhibiting substance in a posterior direction, establishing polarity. This model explains the polaritv

reversal experiments using external fields and many of the previously unexplained classical planarian experiments. Data are presented demonstrating the existence, magnitude, and polarity of this bioelectric field, which is not greatly altered upon decapitation, all in accord with predictions of the model.

6199 High density lipoprotein distribution. Anderson, D.W.; Nichols, A.V.; Pan, S.S.; Lindgren, F.T. (Univ. of California, Berkeley). *Atherosclerosis;* **29**: 161-179(1978).

In an earler report we identified at least 3 major components within the serum total high density lipoprotein (HDL) distribution of normal subjects. In the present study, the serum concentrations of these components, which we designate HDL/sub 2b/, d 1.063 to 1.100 g/ml; HDL/sub 2a/, d 1.100 to 1.125 g/ml; HDL_3, d 1.125 to 1.200 g/ml are determined for 160 clinically-screened subjects from a normal population sample. This determination involves graphically fitting reference schlieren patterns for each of the three components to the subjects' total HDL schlieren patterns with the aid of a computer. The mean error of fitting all three reference patterns was low (9 +- 8% (SD) of total area). Mean serum levels of HDL/sub 2b/ and HDL/sub 2a/ were significantly higher in females than in males for each of the four age decades surveyed (27 to 36, 37 to 46, 47 to 56, and 57 to 66 years). Mean HDL_3 serum levels were slightly higher in males than in females for the population as a whole. Regression of HDL/sub 2b/, HDL/sub 2a/, and HDL_3 levels on each other and on total HDL serum concentration revealed 2 sex-independent trends: (1) HDL_3 levels are negatively correlated ($r = 0.315$) with HDL/sub 2b/ levels, uncorrelated with HDL/sub 2a/ levels, and are relatively constant (mean level 158 +- 30 mg/dl (SD)); (2) HDL/sub 2b/ and HDL/sub 2a/ levels are highly correlated ($r = 0.725$) and displaya progressive build up with increasing total HDL levels. Since HDL/sub 2b/ and HDL/sub 2a/ levels account in major part for the differences in total HDL levels observed, we propose that they may be the critical HDL components determining the reported inverse correlation of HDL cholesterol with coronary heart disease.

6200 Comparative effects of aminotriazole on normal and acatalasemic mice. Feinstein, R.N.; Fry, R.J.M.; Staffeldt, E.F. (Argonne National Lab., IL). *J. Environ. Pathol. Toxicol.;* **1**: 779-790(1978).

Some pharmacological and toxicological effects of dietary 3-amino-1,2,4-triazole (AT), a known catalase inhibitor, antithyroid agent, and carcinogen, have been examined, using acatalasemic (Cs/sup b/) and normal catalase, wild-type (Cs/sup a/) substrains of highly inbred C3H and C57BL mice. It was found that (a) the acatalasemic substrains are more resistant to weight loss and death on the AT diet than are their normal catalase counterparts; (b) Cs/sup b/ and Cs/sup a/ substrains of C57BL mice are more resistant to weight loss and death on the AT diet than are the Cs/sup b/ and Cs/sup a/ substrains of the C3H mouse; (c) the liver catalase, as well as the whole body catalase, of the two C57BL substrains is less inhibited by the AT diet than is that of the C3H substrains; (d) mice consuming the same quantity of either normal or AT-containing diet gain much more weight on the normal diet; (e) temporary consumption of the AT diet causes a considerable increase in thyroid weight, with an extremely slow, and only partial, return toward normal weight; and (f) the C3H/Cs/sup a/ mouse on an AT diet develops a scaly, necrotic tail very similar in appearance to the so-called rodent ringtail; this lesion is never observed in the acatalasemic mouse on the same diet.

6201 Mutagenicity of N-nitrosopiperidines with Salmonella typhimurium/microsomal activation system. Rao, T.K. (Oak Ridge National Lab., TN); Hardigree, A.A.; Young, J.A.; Lijinsky, W.; Epler, J.L. *Mutat. Res.;* **56**: 131-145(1977).

Using Salmonella typhimurium tester strains, we have examined N-nitrosopiperidine and various substituted nitrosopiperidines for their mutageni potency. Most of the nitrosopiperidines require metabolic activation. Phenobarbital appears to be the most effective inducer of the rat liver enzymes. Also observed was a correlation between mutagenicity and carcinogenic potency of these compounds. The carbon atoms alpha to the N-nitroso group seem important since blockage of those positions reduces or eliminates mutagenicity as well as carcinogenicity of the nitrosopiperidine.

6202 Studies on adenosine 3′,5′-phosphate-binding and adenosine 3′,5′-phosphate-dependent protein kinase activities associated with subcellular fractions of Chinese hamster ovary cells. Li, A.P.; Hsie, A.W. (Oak Ridge National Lab., TN). *Biochim. Biophys. Acta;* **500**: 140-151(1977).

Both cyclic AMP-binding and cyclic AMP-dependent protein kinase activities exist in Chinese hamster ovary cell extract. Competition experiments demonstrate that the binding is specific for cyclic AMP. All cellular elements including nucleus, mitochondria, plasma membrane, microsome, ribosome and cytosol contain both activities. Binding activity is highest in the cytosol and lowest in the nucleus. Each fraction contains endogenous protein kinase activity which is insensitive to cyclic AMP activation. When histone was used as a substrate, protein kinase activity in all fractions was stimulated by cyclic AMP (with the highest in cytosol and lowest in the nucleus) and inhibited by Walsh's protein kinase inhibitor.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 6227, 6228, 6229, 6232

6203 Internal electron transfer within mitochondrial succinate-cytochrome C reductase. Ilan, Y. (Hebrew Univ., Jerusalem, Israel). *Biochem. Biophys. Res. Commun.;* **85**: No. 4, 1261-1267(29 Dec 1978).

Internal electron transfer within succinate-cytochrome C reductase from pigeon breast muscle mitochondria was followed by the pulse radiolytic technique. The electron equivalent is transferred from an unknown donor to b type cytochrome(s), in a first order process with a rate constant of: 660 +- $150 s^{-1}$. This process might be the rate determining step of electron transfer in mitochondria, since it is similar in rate to the turnover number of the mitochondrial respiratory chain.

6204 Localization of 1,25-dihydroxyvitamin D_3 in intestinal nuclei in vivo. Zile, M.; Bunge, E.C.; Barsness, L.; Yamada, S.; Schnoes, H.K.; DeLuca, H.F. (Univ. of Wisconsin, Madison). *Arch. Biochem. Biophys.;* **186**: No. 1, 15-24(Feb 1978).

Autoradiography of frozen sections of intestinal tissue taken from rachitic chickens given a single intravenous dose of 1,25-dihydroxy[23,24^{3}H]vitamin D_3 (650 pmol, 78 Ci/mmol) has been carried out. Specific localization of label in the nuclei of intestinal villi and crypt cells could be demonstrated at 2.5 to 6 h postintection. In contrast, no concentration or localization of radioactivity could be detected in intestinal muscle, liver, and skeletal muscle. These results strongly support the concept that the function of 1,25-dihydroxyvitamin D_3 in intestine is mediated by a nuclear mechanism.

CYTOLOGY

REFER ALSO TO CITATION(S) 6192, 6201, 6202, 6215, 6216, 6218, 6247

6205 Effects of localized ultrasonic irradiation on Pisum sativum roots. Law, W.K.; Carstensen, E.L.; Miller, M.W. (Univ. of Rochester, NY). *Environ. Exp. Bot.;* **18**: 207-218(1978).

Histological studies on pea roots sonicated by a broad beam of ultrasound indicated that most of the damage occurs in the elongation region. There is little microscopic evidence of cell destruction in the meristem, and yet this region of dividing cells shows a marked cytokinetic response to sonication. Indirect effects of ultrasound were therefore suspected to exist. By using focused ultrasound to irradiate root segments as small as 1 mm^2, and then observing changes in growth and mitotic index outside the region of sonication, the existence of indirect effects of ultrasound was established. Histological observations on sections of treated roots indicated necrotic nuclei within and without the region of sonication.

6206 Sister chromatid exchange as an assay for genetic damage induced by mutagen-carcinogens. II. In vitro test for compounds requiring metabolic activation. Stetka, D.G.; Wolff, S. (Univ. of California, San Franscisco). *Mutat. Res.;* **41**: 343-350(Dec 1978).

Sister chromatid exchanges (SCE's) which are easily seen by "harlequin chromosome" techniques can be readily induced in cultured Chinese hamster ovary (CHO) cells by low concentration of mutagen-carcinogens that do not require metabolic activation. If the cells are simultaneously treated with cyclophosphamide which does require metabolic activation before it becomes mutagenic, and an activating system consisting of an extract of rat liver containing microsomes (S-9 Mix) then numerous SCE's are induced by the compound. This indicates that the induction of sister chromatid exchanges in such cells can be used as an in vitro assay for mutagens that require activation as well as those that do not. The method, which is very simple and quick is more sensitive than is the usual cytogenetic assay in which chromosome aberrations are assayed.

6207 Serum protein depletion by cultured rat embryos. Klein, N.W.; Minghetti, P.P.; Jackson, S.K.; Vogler, M.A. (Univ. of Connecticut, Storrs). *J. Exp. Zool.;* **203**: No. 2, 313-318(Feb 1978).

Cultures of 10-day rat embryos depleted a protein band with a molecular weight of approximately 125,000 from the rat serum medium. Delayed centrifuged serum differed from immediately centrifuged serum by a reduction in the staining intensity of the 125,000 molecular weight protein band and by the absence of two high molecular weight (>200,000) protein bands.

6208 Immunofluorescent analysis of murine leukemia virus-infected cells by flow microfluorometry. Hand, R.E. Jr.; Tennant, R.W.; Yang, W.K.; Lavelle, G.C. (Oak Ridge National Lab., TN). *J. Immunol. Methods;* **23**: 175-186(1978).

Flow microfluorometric assay with a Cytofluorograf model 4801 in combination with immunofluorescence was applied to the quantitative assay of cells exogenously infected with mouse leukemia viruses and to the chemical induction of virus in AKR cells. The Cytofluorograf provides sensitivity equal to the visual method and is capable of assaying up to 5000 cells/sec with specificity equivalent to that of the direct visual immunofluorescence assay, thereby providing a large, statistically valid sampling in a fraction of the time required by visual counting. Flow microfluorometry also provides a method of quantitatively resolving fluorescent cell populations on the basis of relative size and degree of fluorescence.

6209 Differential effects of erythrocyte lysates on spectra of potential-sensing carbocyanine dyes. Guillet, E.; Kimmich, G. (Univ. of Rochester, NY). *Biochim. Biophys. Acta;* **509**: 385-389(1978).

A report by Hladky and Rink demonstrates the binding of a thiocarbocyanine dye (di-S-C_3(5)) to an intracellular constituent from human erythrocytes. Evidence presented shows that the binding of carbocyanine dyes depends on the particular type of dye used and on the species of erythrocyte from which cellular constituents are prepared. It is recommended that dyes which show minimal binding to intracellular components be used for investigations where carbocyanine dyes are employed as probes of membrane potential.

6210 Growth arrest of Chinese hamster ovary cells in serum-free medium: changes in cell morphology and the intracellular and prostaglandin-induced levels of cyclic AMP. O'Neill, J.P.; Hsie, A.W. (Oak Ridge National Lab., TN). *J. Cyclic Nucleotide Res.;* **4**: 169-174(1978).

When Chinese hamster ovary (CHO) cells are shifted from medium which contains serum into serum-free medium, they complete one cell doubling and arrest in the G_1 phase of the cell cycle. During the first 72 h of arrest, there is little change in intracellular adenosine 3′ : 5′-phosphate (cAMP) level, and the cells retain their usual epithelial-like morphology. After 96 h, the cAMP level doubles, the magnitude of the prostaglandin E_1-induced changes in cAMP increases threefold, and the cells convert from a rounded, epithelial-like shape to an elongated, fibroblast-like form. The fact that these biochemical and cellular transitions are subsequent to the growth arrest shows that the cAMP increase is not the cause of the growth arrest but is consistent with a role for cAMP in the control of cell morphology. In addition, these changes point to the importance of the G_1 phase for initiating cAMP-related events.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 6232

6211 (LBL—9662) **Interactions of 4-nitroquinoline-1-oxide with nucleic acids.** Winkle, S.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 228p. Dep. NTIS, PC A11/MF A01.

Thesis.

The interactions of 4-nitroquinoline-1-oxide (NQO) with deoxyribomononucleotides, deoxyribodinucleotides and DNA were studied. The noncovalent complexes were studied using absorption spectra of the charge transfer bands and nuclear magnetic resonance (NMR) spectra of the NQO nucleic acid mixtures. Absorption spectra for the monomer-NQO and dimer-NQO systems were analyzed using Benesi-Hildebrand type equations to yield stoichiometries and equilibrium constants of complex formation. The results of the latter suggest the performance of NQO for the quanine residue in a DNA. Irradiation of NQO-polynucleotide mixtures and NQO-DNA mixtures using either a mercury lamp source (340 to 420 nm) or a dye laser (400 to 415 nm) produced photoadducts. DNA-NQO equilibria were studied using analysis of the complex absorption bands (415 nm) and using the phase partition technique. Two NQO molecules bind strongly and cooperatively to a small number of sites on the DNA. Results suggest that NQO binds to cruciform-like structures in the DNA. (DMC)

GENETICS

REFER ALSO TO CITATION(S) 6215

METABOLISM

REFER ALSO TO CITATION(S) 6190, 6194, 6230

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 6204, 6227, 6228

MEDICINE

REFER ALSO TO CITATION(S) 6220, 6221, 6222, 6223, 6224, 6225, 6226

6212 (LA-UR—79-1822) **Treatment of bovine cancer-eye (and other animal tumors) with heat.** Doss, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 38p. (CONF-800105—1). Dep. NTIS, PC A03/MF A01.

From 17. annual international Stockmen's School; Tucson, AZ, USA (7 Jan 1980).

Hyperthermia appears to be an excellent technique for the treatment of a variety of animal tumors. While this report has emphasized the application of hyperthermia to bovine cancer-eye, there cannot be serious doubt about the potential for wider applications of the technique. We have collaborated with the Animal Resource Facility at the University of New Mexico in the successful treatment of a variety of tumors in small animals which would not be a particular interest to stockmen, but the program included the successful treatment of a number of sarcoids in horses. This investigation involving heat effects on sarcoids will continue, but early results appear to be promising. Other veterinarians are using the commercial hyperthermia instruments to treat a variety of small-animal tumors; these practitioners are enthusiastic about the results but no data have been published to date. We have treated an equine lid tumor with good results, and others are pursuing investigations in this area. Use of commercial hyperthermia instruments for treatment of any condition other than bovine cancer-eye or similar small tumors on animals cannot be justified. Like other therapeutic techniques, hyperthermia must be applied to appropriate cases and retreatment will be necessary in some instances. (ERB)

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 6024

6213 Cadmium telluride gamma camera. Entine, G.; (Radiation Monitoring Devices, Inc., Watertown, MA); Luthmann, R.; Mauderli, W.; Fitzgerald, L.T.; Williams, C.M.; Tosswill, C.H. *IEEE Trans. Nucl. Sci.;* **26**: No. 1, 552-558(Feb 1979).

A small 4 cm x 4 cm prototype CdTe gamma camera has been constructed which demonstrates sensitivity and spacial resolution superior to the standard Anger camera. The camera is based on an array of linear solid state detectors contained within a laminar collimator which confines the field of view to one dimension. The array is rotated stepwise through 180° and data from each position recorded and computer processed. This technique leads to a major enhancement in sensitivity relative to the multihole collimator. Clinical images have been obtained and a larger CdTe camera is planned.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 6201, 6208

6214 (SAN—0034-T2) **Integrated system for the conversion of solar energy with sewage grown microalgae. Final report, October 1, 1976-September 30, 1977.** Benemann, J.R.; Weissman, J.C.; Eisenberg, D.M.; Koopman, B.L.; Goebel, R.P.; Caskey, P.S.; Thomson, R.D.; Oswald, W.J. (California Univ., Berkeley (USA). Sanitary Engineering Research Lab.). Jun 1978. Contract EY-76-S-03-0034-251. 259p. Dep. NTIS, PC A12/MF A01.

An integrated system for wastewater treatment and microalgae biomass production for conversion to fuels is proposed. Progress in the development of low cast biomass production system using sewage as a source of nutrients and water is reported. The theory of species control through selective biomass recycle is refined and demonstrated in laboratory experiments. The outdoor pond system was further developed and microstrainer effectiveness tested in multivariant experiments. The outdoor pond operations consisted of a series of experiments to test the effects of detention time, recycling and mixing on algae culture harvestability, and productivity. Batch and continuous secondary growth ponds were operated to result in low ammonia pond effluents, after algae settling or microstraining. These effluents were used to grow nitrogen-fixing blue-green algae. The 0.25 hectare pond was operated to determine whether small scale experimental results can be extrapolated.

6215 Variation of phenotypic suppression due to the psi+ and psi- extrachromosomal determinants in yeast. Palmer, E.; Wilhelm, J.M.; Sherman, F. (Univ. of Rochester School of Medicine and Dentistry, NY). *J. Mol. Biol.;* **128**: 107-110(1979).

Paromomycin, an aminoglycoside antibiotic, can phenotypically suppress nonsense mutations in the yeast Saccharomyces cerevisiae. We report here that the extrachromosomal determinant, psi$^+$

enhances this phenotypic suppression of all three nonsense mutations, UAG, UAA and UGA, by three- to sevenfold.

6216 Attempts to induce mutations in Haemophilus influenzae with the base analogues 5-bromodeoxyuridine and 2-aminopurine. Kimball, R.F.; Perdue, S.W. (Oak Ridge National Lab., TN). *Mutat. Res.;* **44**: 197-206(1977).

Attempts were made to induce mutations in Haemophilus influenzae with the base analogues 5-bromodeoxyuridine and 2-aminopurine. These attempts were unsuccessful. Incorporation studies with BrdUrd showed, in agreement with earlier studies on Escherichia coli, that BrdUrd was discriminated against when dThd was also present but was incorporated to essentially the same extent as dThd when only BrdUrd was present. In this latter case, strands fully substituted with BrdUrd were produced, but survival data suggest that bacteria deriving their DNA by replication on such fully substituted templates were inviable. However, bacteria with about 20% of the thymine substituted with bromouracil were usually viable. No mutations could be detected in the descendants of such bacteria. The reasons for this are discussed and it is concluded that in all probability the replication system in species rarely if ever treats incorporated bromouracil as anything except a thymine analogue. The alternative possibility, that the negative results are a consequence of the absence of the reclex (SOS) error-prone repair system in this species, is considered much less likely.

MORPHOLOGY

REFER ALSO TO CITATION(S) 6210, 6217

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 6200, 6209, 6255

6217 (COO—3377-T2) **Age changes in human bone: an overview.** Sharpe, W.D. (Cabrini Medical Center, New York (USA)). 3 Dec 1977. Contract EY-76-S-02-3377. 20p. Dep. NTIS, PC A02/MF A01.

The human skeleton steadily changes structure and mass during life because of a variety of internal and external factors. Extracellular substance and bone cells get old, characteristic structural remodeling occurs with age and these age-related changes are important in the discrimination between pathological and physiological changes. Perhaps 20 percent of the bone mass is lost between the fourth and the ninth decades, osteoblasts function less efficiently and gradual loss of bone substance is enhanced by delayed mineralization of an increased surface area of thin and relatively less active osteoid seams. After the fifth decade, osteoclasia and the number of Howship's lacunae increase, and with age, the number of large osteolytic osteocytes increases as the number of small osteocytes declines and empty osteocyte lacunae become more common. The result is greater liability to fracture and diminished healing or replacement of injured bone.

6218 Proliferative potential of plasma clot erythroid colony-forming cells in diffusion chambers. Gerard, E.; Carsten, A.L.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY). *Blood Cells;* **4**: 105-128(1978).

Rat bone marrow from normal or exhypoxic donors was cultured in plasma clot diffusion chambers implanted in normal, hypoxic, and/or irradiated-hypoxic hosts. Bone marrow from exhypoxic rats is markedly suppressed in the recognizable erythron (RE) and the non-recognizable erythron (NRE) is arrested at a more undifferentiated level with marked decrease in colony-forming unit erythroid (CFU-E) content and increase in burst-forming unit erythroid (BFU-E) content. When normal bone marrow is grown in normal hosts the size distribution of the colonies on the third day is comparable to that observed in in vitro culture. The colony number on day 8 is one-third of that on day 3 and the average colony size is five times larger than that on day 3. In contrast, cells in hypoxic hosts produce neary twice as many colonies by the second day with nearly twice the average number of cells, and by the seventh day, one-ninth the number of colonies are seen with the average size about eight times larger. When the exhypoxic cells are grown in the normal host the colony yield is trivial and the average size small. However, when grown in the hypoxic of hypoxic-irradiated host the exhypoxic cells produce large numbers of colonies with a wide spectrum of colony size from 50 to greater than 2000 cells. The size distribution of colonies is a function of time in culture and intensity of the stimulus for erythropoiesis.It takes 7 days for colonies to appear when exhypoxic cells are grown in normal host, whereas a wide spectrum of colony sizes are seen at 4 days when grown in the hypoxic or the hypoxic-irradiated host. In the hypoxic-irradiated host the largest colonies are seen earlier and colony numbers thus decrease by enucleation and disappearance of the erythrocytes while the colonies are still growing in the hypoxic host.

6219 Inhibition of diffusion chamber (DC) granulopoiesis by anti-CSF serum. Shadduck, R.K.; Carsten, A.L.; Chikkappa, G.; Cronkite, E.P.; Gerard, E. (Univ. of Pittsburgh School of Medicine, PA). *Proc. Soc. Exp. Biol. Med.;* **158**: 542-549(1978).

Diffusion chamber granulopoiesis was studied in irradiated mice injected with anti-colony stimulating factor (CSF)serum. Total cellularity, proliferative and nonproliferative granulocytes were markedly suppressed by 4 days injection of antiserum. Moreover, granulocytic stem cells were markedly decreased. This suggests that CSF is necessary for maintaining the integrity of the granulocytic stem cell and for inducing differentiating granulopoiesis.

TRACER TECHNIQUES

6220 (PB—290429) **Percutaneous absorption of topically applied DTIC-14C (NSC-45388) in Yorkshire white pigs. Final report, 14 September-14 November 1976.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 1 Mar 1978. Contract N01-CM-4-3746. 20p. NTIS PC A02/MF A01.

The absorption of topically applied DTIC (5-(3,3-dimethyl-1-triazeno) imidazole-4-carboxamide-2-14C) (NSC-45388) was studied in female, weanling, Yorkshire white pigs. After 48 hours, an average of 9.61% of the topically applied dose was excreted in the urine of the test animals. Liver and kidney showed the most consistent uptake of radioactivity with heart and adrenal samples also showing significant uptake. Radioactivity was detected in random muscle samples at 6 hours after application, and in bone after 48 hours. A significant percentage of the applied dose was generally detected at and near the site of application.

6221 (PB—290430) **Intravenous elimination and percutaneous absorption of topically applied guanazole-14C (NSC-1895) in Yorkshire white pigs. Final report, 2 August 1976-7 December 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 1 Mar 1978. Contract N01-CM-4-3746. 30p. NTIS PC A03/MF A01.

The elimination of intravenously administered Guanazole-14C was studied in female, weanling, Yorkshire white pigs to determine the total percentage of such a dose eliminated in the urine. Ninety-six percent of the dose was eliminated after 72 hours. This elimination percentage was then utilized to determine the amount of Guanazole-14C absorbed after topical application of the drug. After 48 hours, approximately 0.2% of the topically applied dose was absorbed through the skin of the test animals. Most tissue levels were not significant. However, adrenals and ovaries, although small, showed high specific activity levels of radioactivity. Bone samples after 24 hours also showed significant uptake. A significant percentage of the applied dose was generally detected at and around the site of application.

6222 (PB—290431) **Intravenous elimination and percutaneous absorption of topically applied procarbazine-14C (NSC-77213) in Yorkshire white pigs. Final report, 8 December 1976-30 April 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Dames and Moore, Boston, MA (USA)). 1 Mar 1978. Contract N01-CM-4-3746. 32p. NTIS PC A03/MF A01.

The elimination of intravenously administered Procarbazine-14C was studied in female weanling Yorkshire white pigs to determine the total percentage of such a dose eliminated in the urine. Maximum elimination of 74% was seen after 48 hours. This elimination percentage was then utilized to determine the amount of Procarbazine-14C absorbed after topical application of the drug. After 48 hours approximately 1% of a topically applied dose was absorbed through the test animals. Blood and tissue levels were also measured at 6, 24, and 4, 24, and 48 hours and in most cases showed negligible accumulation. Exceptions were the random samples of bone, fat, and abdominal skin which repeatedly showed significant levels of radioactivity. A significant percentage of the applied dose was generally detected at the application site after sacrifice.

6223 (PB—290432) **Intravenous elimination and percutaneous absorption of topically applied 14C-cytosine-arabinoside (ARA C) (NSC-63878) in Yorkshire white pigs. Final report, 25 March-14 July 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Litterst, C.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 10 Mar 1978. Contract N01-CM-4-3746. 32p. NTIS PC A03/MF A01.

The elimination of intravenously administered 14C-Cytosine-Arabinoside (Ara-C) was studied in female, weanling, Yorkshire white pigs to determine the total percentage of such a dose eliminat-

ed in the urine. Eighty-three percent of the dose was eliminated after 72 hours. This elimination percentage was then utilized to determine the amount of 14C-Ara C absorbed after topical application of the drug. After 48 hours, approximately 0.4% of the topically applied dose was absorbed through the skin of the test animals. Most tissue levels were not significant. However, fat at 6 hours and bone at 48 hours had high specific activity levels of radioactivity. Adrenals showed the only significant uptake in the whole organs assayed. A significant percentage of the applied dose was generally detected at and around the site of application.

6224 (PB—290433) **Intravenous elimination and percutaneous absorption of topically applied hexamethylmelamine-14C (NSC-13875) in Yorkshire white pigs. Final report, 28 June-4 October 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 1 Mar 1978. Contract N01-CM-4-3746. 36p. NTIS PC A03/MF A01.

The distribution and elimination of intravenously administered Hexamethylmelamine-14C (NSC-13875) was studied in female, weanling, Yorkshire white pigs. The majority of the radioactivity eliminated in the urine was detected in the first 24 hours. After 96 hours (4 days) an average of 89% was eliminated via the urine. This elimination percentage was then utilized to determine the amount of Hexamethylmelamine-14C absorbed after topical application of the drug. Among the whole organs sampled, kidney, liver and adrenals had the highest specific activities of radioactivity. Bone marrow samples had the highest specific activity levels of the random tissues sampled. Percutaneous studies showed an average absorption percentage of 5.13% of the applied dose during the first 48 hours. At the end of 192 hours (8 days) the total percentage absorbed was 6.76%. Significant levels of radioactivity were also detected in skin surrounding the site of application.

6225 (PB—290435) **Intravenous elimination and percutaneous absorption of topically applied mercaptopurine-14C (NSC-755) in Yorkshire white pigs. Final report, 22 June-15 October 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 20 Mar 1978. Contract N01-CM-4-3746. 37p. NTIS PC A03/MF A01.

The distribution and elimination of intravenously administered Mercaptopurine-14C (NSC-755) was studied in female, weanling, Yorkshire white pigs. Over one-half the radioactivity was eliminated in the urine in the first six hours. After 96 hours (4 days), an average of 80% was eliminated in the urine. This elimination percentage was then used to determine the amount of Mercaptopurine-14C absorbed after topical application. Among the whole organs sampled, kidney and liver had the highest specific activities of radioactivity. A blood-brain barrier appears to exist. Bone marrow had the highest specific activity level of the random tissues sampled. The absorption of Mercaptopurine-14C after topical application was minimal with approximately 1.51% of the applied dose being absorbed at the end of 192 hours (8 days). Significant levels of radioactivity were also detected in skin surrounding the site of application.

6226 (PB—290436) **Intravenous elimination and percutaneous absorption of topically applied melphalan-14C (NSC-8806) in Yorkshire white pigs. Final report, 17 August-1 December 1977.** Skierkowski, P.; Murphy, J.C.; Watson, E.S.; Folk, R.M.; Pavkov, K.L. (Battelle Columbus Toxicology Program Office, McLean, VA (USA); Mississippi Univ., University (USA). Research Inst. of Pharmaceutical Sciences). 28 Mar 1978. Contract N01-CM-4-3746. 41p. NTIS PC A03/MF A01.

The distribution and elimination of intravenously administered Melphalan-14C (NSC-8806) was studied in female, weanling Yorkshire white pigs. A three compartment pharmacokinetic model is indicated with a very slow elimination phase (half life = 214 hours). Assay of tissue samples indicate bone and fat may be acting as depots for the drug. After 8 days an average of 70% was eliminated via the urine. Percutaneous studies showed an average of 4.02% of the applied dose was absorbed after 14 days. Significant levels of radioactivity were also detected in skin surrounding the site of application.

6227 **Effect of dietary calcium and phosphorus on intestinal calcium absorption and vitamin D metabolism.** Ribovich, M.L.; DeLuca, H.F. (Univ. of Wisconsin, Madison). *Arch. Biochem. Biophys.;* **188**: No. 1, 145-156(May 1978).

To understand better dietary regulation of intestinal calcium absorption, a quantitative assessment of the metabolites in plasma and duodenum of rats given daily doses of radioactive vitamin D_3 and diets differing in calcium and phosphorus content was made. All known vitamin D metabolites were ultimately identified by high-pressure liquid chromatography. In addition to the known metabolites (25-hydroxyvitamin D_3, 24,25-dihydroxyvitamin D_3, 1,25-dihydroxyvitamin D_3, 25,26-dihydroxyvitamin D_3, and 1,24,25-trihydroxyvitamin D_3), several new and unidentified metabolites were found. In addition to 1,25-dihydroxyvitamin D_3 and 1,24,25-trihydroxyvitamin D_3, the levels of some of the unknown metabolites could be correlated with intestinal calcium transport. However, whether or not any of these metabolites plays a role in the stimulation of intestinal calcium absorption by low dietary calcium or low dietary phosphorus remains unknown.

6228 **Adaptation of intestinal calcium absorption: parathyroid hormone and vitamin D metabolism.** Ribovich, M.L.; DeLuca, H.F. (Univ. of Wisconsin, Madison). *Arch. Biochem. Biophys.;* **188**: No. 1, 157-163(May 1978).

It has already been demonstrated that the adaptation of intestinal calcium absorption of rats on a low calcium diet can be eliminated by thyroparathyoidectomy plus parathyroid hormone administration. It therefore appears likely that the modulation of intestinal calcium absorption by dietary calcium is mediated by the parathyroid glands and the renal biogenesis of 1,25-dihydoxyvitamin D_3. Changes in the other unknown vitamin D metabolite levels as a result of dietary calcium are also modified by thyroparathyroidectomy and parathyroid hormone administration, but the effect of these metabolites on intestinal calcium transport is unknown.

6229 **Stimulation of lead absorption by vitamin D administration.** Smith, C.M.; DeLuca, H.F.; Tanaka, Y.; Mahaffey, K.R. (Univ. of Wisconsin, Madison). *J. Nutr.;* **108**: No. 5, 843-847(May 1978).

Two methods for the determination of lead absorption have been developed using the rat as the test animal. One is an everted intestinal sac method in which the time course of ^{210}Pb transport across intestinal wall can be followed in vitro; and the other, ^{210}Pb absorption from the intestine following gastric intubation can be followed in vivo. By using these techniques it can be clearly demonstrated that vitamin D markedly enhances lead absorption. Both techniques provide evidence that the distal small intestine is the major site of lead absorption and the site of greatest vitamin D stimulation. Lead acetate is apparently absorbed to the extent of 45% as it passes through the small intestine at a concentration of 0.01 mM.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 6212

TRACER TECHNIQUES

6230 **Seasonal changes in within-canopy allocation of ^{14}C-photosynthate by white oak.** McLaughlin, S.B. (Oak Ridge National Lab., TN); McConathy, R.K.; Beste, B. *For. Sci.;* **25**: No. 2, 361-370(1979).

Seasonal changes in photosynthate translocation and allocation of two mature, codominant white oak trees were studied by following rates of movement of ^{14}C-photosynthate from foliage labeled with $^{14}CO_2$. Loss rates were determined by sampling foliage at 5 min and 1, 4, and 7 days after labeling on each of five dates (April 22 to October 4). Incorporation of ^{14}C-photosynthate into 1-, 3-, and 5-year-old branches was determined 7 days after tagging. Losses of ^{14}C from leaves were rapid by day 1 (less than or equal to 80 percent), greatly reduced by day 4, and ranged fom 63 to 91 percent by day 7. Maximum retention of initial activity levels occurred in April for leaves (44 percent) and in October for branches (15 percent). Approximately equal apportionment of activity between leaves and branches did not occur until August. Highest total retention of photosynthate in the canopy occurred in April (due to high incorporation in leaves) and June (due to high retention in both leaves and branches). Based on measured retention and estimated respiration losses, translocation of the original ^{14}C-photosynthate from the canopy was calculated to be approximately 0 percent in April, 30 percent in June, and 60 percent in October. These results indicate that canopy growth and maintenance impose a significant drain on availability of photosynthate throughout the growing season.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN ANIMALS

6231 (NUREG/CR—0894) **Power plant entrainment simulation utilizing a condenser tube simulator. Annual report, December**

1977-November 1978. O'Connor, J.M.; Poje, G.V. (New York Univ., NY (USA). Medical Center). Jul 1979. 116p. NTIS.

Striped bass, Gammarus, and Neomysis from the Hudson River estuary were subjected to passage through a condenser tube simulator at various combinations of temperatures, flow rate, and biocide concentration. Striped bass yolk sac stages were more susceptible to all stressors than older larval fish. The youngest larvae exhibited 50% mortality immediately after 10 min exposures to temperatures above 31°C; for older larvae this was observed at temperatures above 33°C. Flow rates above 2 meters per second through the condenser tube resulted in an initial 3% mortality of yolk sac larvae, while 16 day old larvae displayed no initial mortality at flow rates as high as 3.0 mps At biocide concentrations greater than 1.0 parts per million of residual chlorine, more than half the yolk sac larvae died immediately after a 10 min exposure. At chlorine doses as high as 2.7 ppM, 31 day old fish survived at a rate of at least 70%; among certain groups, 100% survival was observed. However, latent survival of these fish was reduced to 0% at a dose of 1.57 ppM. For mixed populations of G. tigrinus and G. daiberi, thermal doses above 39°C for both 10 and 30 min exposures were lethal. When Neomysis americana was subjected for 10 and 30 min to temperatures above 34°C, 24 h mortalities were greater than 50%. Flow rates of 1.0, 2.0, and 3.0 mps had no detectable effect upon either Gammarus or Neomysis. Ten minute exposures to residual chlorine concentrations above 1.4 ppM resulted in greater than 50% latent mortality for the amphipod. Neomysis americana displayed latent mortality as high as 90% after a 10 min exposure to residual chlorine doses as low as 0.75 ppM. Larval fish and macroinvertebrates exposed to condenser tube passage had lower survival than those which were only plume entrained. In experiments where flow rate and biocide concentrations varied, the addition of a sublethal thermal exposure increased the mortality.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

6232 (CONF-790992—1) **Ultraviolet and chemical induced DNA repair in human cells assayed by bromodeoxyuridine photolysis or cytosine arabinoside arrest.** Regan, J.D.; Dunn, W.C. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From FEBS symposium on DNA; Prague, Czechoslovakia (24 Sep 1979).

The bromodeoxyuridine photolysis assay of DNA damage in human cells permits an estimate of both the number of repaired regions in the DNA and the size of the average repaired region - the patch size. The antineoplastic agent arabinofuranosyl cytosine (ara-C) can also be employed to assay the magnitude of repair since this agent appears to block rejoining of single-strand incisions made in the DNA during the initial step of repair. Thus, the number of incisions can be accumulated. The ara-C effect is dependent on the presence of hydroxyurea. Both assays can be employed for the study of physical or chemical DNA damages. Results comparing these assays are presented.

6233 (COO—3110-31) **Cellular heredity in haploid cultures of somatic cells. Progress report, August 1978-September 1979.** Freed, J.J. (Institute for Cancer Research, Philadelphia, PA (USA). Fox Chase Cancer Center). Oct 1979. Contract EY-76-S-02-3110. 10p. Dep. NTIS, PC A02/MF A01.

During the past year we have continued our studies of the relation of ultraviolet mutagenesis to DNA repair in cultures of the haploid frog cell line ICR 2A. Our method of irradiation of cells in suspension was improved by construction of an improved detector with major sensitivity to the 254 nm Hg resonance line, to give better estimates of actual exposure of the cells. Using this method, dose-response and dose-fractionation studies on irradiation of ouabain resistance were carried out. The uv induction of this phenotype in the ICR 2A cell line was found to be less than that necessary for adequate analysis of dose-response curves. Cell fusion experiments using frog and mouse cells revealed an enhancement of mutagenesis in the mouse parent that will be explored in further work.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

6234 (PNL-SA—6950) **Use of high dose rate electron beams to study cellular repair mechanisms.** Braby, L.A.; Nelson, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 5p. (CONF-781113—40). Dep. NTIS, PC A02/MF A01.

From 5. conference on application of small accelerators; Denton, TX, USA (6 Nov 1978).

Repair of sublethal damage produced by ionizing radiation is an important factor influencing cellular survival. This is particularly so when low dose rates, as encountered in environmental exposures, are involved. Since repair processes may have characteristic times ranging from nanoseconds to hours, conventional radiation sources are not capable of giving the range of dose rates needed for a systematic investigation. A 2 MV electrostatic accelerator has been modified to generate an electron beam to satisfy this requirement. This accelerator and associated electronic controls have been used to demonstrate that the repair process responsible for the altered survival observed after split-dose irradiations is the same as that responsible for the shoulder of the survival curve for Chlamydomonas reinhardi. Furthermore, it has made possible the identification and measurement of the rates of two repair processes which function concurrently in these cells.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 6163, 6238

6235 (LA-UR—79-3140) **Acceptable respiratory protection program and LASL respirator research.** Skaggs, B.J. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 27p. (CONF-791088—2). Dep. NTIS, PC A03/MF A01.

From National safety congress; Chicago, IL, USA (15 Oct 1979).

A short history is presented on the LASL Respiratory Protection Training Programs. Then a discussion is given on the major points of an acceptable respiratory protection program utilizing the points required by the Occupational, Safety, and Health Administration (OSHA) Regulation 29 CFR 1910.134. Contributions to respirator research are reviewed. Discussion is presented under the following section headings: program administration; respirator selection; respirator use; fitting and training; respirator maintenance; medical clearance and surveillance; special problems; program evaluation; and documentation (records).

6236 (PB—290215) **Radiation protection activities - 1977. Annual report.** (Environmental Protection Agency, Washington, DC (USA). Office of Radiation Programs). Aug 1978. 142p. NTIS PC A07/MF A01.

The report is designed to survey in some detail the activities of several Federal agencies involved in radiation protection-such as controlling medical x-ray exposures, managing nuclear power plant effluents, protecting workers exposed to radiation, and monitoring fallout. In addition some of the less obvious activities are referred to, to give readers a sense of scope of Federal involvement. The division of responsibilities within the Federal government is defined, and some relevant congressional and judicial actions are summarized in the introduction. A list of pertinent 1977 Federal publications is provided.

VERTEBRATES

6237 **Interactions of ionizing radiation, nitrosamines, sulfonoxyalkanes and antioxidants as they affect carcinogenesis and survival in mice.** Clapp, N.K. (Oak Ridge National Lab., TN). *Am. Ind. Hyg. Assoc. J.*; 39: 448-453, 688(Jun 1978).

Butylated hydroxytoluene (BHT) pretreatment of 8-wk-old BALB/c mice for 28 days protected against 30-day lethality by x-rays, diethylnitrosamine (DEN), dimethylnitrosamine (DMN) and ethyl methanesulfonate (EMS) but not against methyl methanesulfonate (MMS). In x-ray survivors, neither mean survival nor leukemia incidences were affected by BHT. However, BHT (lifetime), given alone or with DEN (300 mg/kg BW in H_2O) or 250 R x-rays, increased irradiated survivors at 18 months but not leukemia or tumor incidences. BHT + DEN treated females had increased survival and a decreased frequency of forestomach squamous carcinomas compared with DEN alone; no differences were seen in males or in pulmonary adenomas. In x-ray + DEN treated females, effect upon survival was additive, but the specific diseases causing this effect were not identified.

MAN

REFER ALSO TO CITATION(S) 6161, 6238, 6241, 6243

ANIMALS

REFER ALSO TO CITATION(S) 6243

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 6161, 6163, 6243

6238 (BNL—26797) **Dosimetry methods and results for the former residents of Bikini Atoll.** Greenhouse, N.A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 25p. (CONF-791122—1). Dep. NTIS, PC A02/MF A01.

From 2. Asian regional congress on radiation protection; Manila, Philippines (5 Nov 1979).

The US Government utilized Bikini and Enewetak Atolls in the northern Marshall Islands of Micronesia for atomspheric tests of nuclear explosives in the 1940's and 1950's. The original inhabitants of these atolls were relocated prior to the tests. During the early 1970's, a small but growing population of Marshallese people reinhabited Bikini. Environmental and personnel radiological monitoring programs were begun in 1974 to ensure that doses and dose commitments received by Bikini residents remained within US Federal Radiation Council guidelines. Dramatic increases in ^{137}Cs body burdens among the inhabitants between April 1977 and 1978 may have played a significant role in the government decision to move the 140 Bikinians in residence off of the atoll in August 1978. The average ^{137}Cs body burden for the population was 2.3 μCi in April 1978. Several individuals, however, exceeded the maximum permissible body burden of 3 μCi, and some approached 6 μCi. The resultant total dose commitment was less than 200 mrem for the average resident. The average total dose for the mean residence interval of $\sim$ 4.5 years was about 1 rem. The sources of exposure, the probable cause of the unexpected increase in ^{137}Cs body burdens, and the methods for calculating radionuclide intake and resultant doses are discussed. Suggestions are offered as to the implications of the most significant exposure pathways for the future inhabitation of Bikini and Enewetak. (ERB)

6239 (LA-UR—79-2782) **Autopsy Tissue Program.** Fox, T.; Tietjen, G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 50p. (CONF-791076—1). Dep. NTIS, PC A03/MF A01.

From DOE statistical symposium; Oak Ridge, TN, USA (25 Oct 1979).

The Autopsy Tissue Program was begun in 1960. To date, tissues on 900 or more persons in 7 geographic regions have been collected and analyzed for plutonium content. The tissues generally consist of lung, liver, kidney, lymph, bone, and gonadal tissue for each individual. The original objective of the program was to determine the level of plutonium in human tissues due solely to fallout from weapons testing. The baseline thus established was to be used to evaluate future changes. From the first, this program was beset with chemical and statistical difficulties. Many factors whose effects were not recognized and not planned for were found later to be important. Privacy and ethical considerations hindered the gathering of adequate data. Since the chemists were looking for amounts of plutonium very close to background, possible contamination was a very real problem. Widely used chemical techniques introduced a host of statistical problems. The difficulties encountered touch on areas common to large data sets, unusual outlier detection methods, minimum detection limits, problems with Aliquot sizes, and time-trends in the data. The conclusions point out areas to which the biologists will have to devote much more careful attention than was believed.

6240 (LA-UR—79-2830) **Determination of americium and plutonium in autopsy tissue: methods and problems.** Boyd, H.A.; Eutsler, B.C.; McInroy, J.F. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 30p. (CONF-791077—1). Dep. NTIS, PC A03/MF A01.

From Workshop on measurement and interpretation of actinide accumulation by man; Snowbird, UT, USA (14 Oct 1979).

The current methods used by the tissue analysis program at LASL for the determination of americium and plutonium in autopsy tissue are described. Problems affecting radiochemical yield are discussed. Included are problems associated with sample preparation, separation of plutonium from large amounts of bone ash, and reagent contamination. The average ^{242}Pu tracer yield for 1800 Pu determinations is 78 +- 12%. The average ^{242}Am tracer yield is 85 +- 7% for 40 determinations.

6241 (UCRL—83328) **Radiation safety and health effects related to low-level radioactive wastes.** King, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Sep 1979. Contract W-7405-ENG-48. 22p. (CONF-7710224—1). Dep. NTIS, PC A02/MF A01.

From Western occupational health conference; Monterey, CA, USA (11 Oct 1977).

The hazards associated with low-level radioactive waste, one of the nation's greatest concerns, are discussed from a health physicist's perspective. Potential biological hazards, four stages of the low-level radioactive waste disposal process, and suggested methods of reducing the risks of handling and disposal, based on previous studies, are defined. Also discussed are potential pathways of human exposure and two scenarios designed to demonstrate the complexity of modeling exposure pathways. The risks of developing a fatal cancer from exposure to the radioactive material, should it occur, is compared to other more commonly accepted risks.

6242 (UCRL—83548) **In vivo measurement of actinides in the human lung.** Anderson, A.L.; Campbell, G.W.; Griffith, R.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1979. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

The problems associated with the in vivo detection and measurement of actinides in the human lung are discussed together with various measurement systems currently in use. In particular, the methods and calibration procedures employed at the Lawrence Livermore Laboratory, namely, the use of twin Phoswich detectors and a new, more realistic, tissue-equivalent phantom, are described. Methods for the measurement of chest-wall thickness, fat content, and normal human background counts are also discussed. Detection-efficiency values and minimum detectable activity estimates are given for three common actinides, ^{238}Pu, ^{239}Pu, and ^{241}Am.

ANIMALS

REFER ALSO TO CITATION(S) 6254

6243 (DOE-tr—190) **Problems of the radiobiology of americium-241.** Moskalev, Yu.I. (ed.). Dec 1979. Translation of Problemy Radiobiologii Ameritsiya-241, Atomizdat, Moscow, 1977. (VAAP/SA—79/23). 161p. Dep. NTIS, PC A08/MF A01.

This book analyzes the patterns of distribution and biological effects of ^{241}Am after different routes and rates of intake. Much attention is given to analysis of macrodistribution and microdistribution of ^{241}Am, including the case when the nuclide enters the body through respiratory organs. The distinctions of the radiation lesion as a function of amount of americium administered and dosage accreted in animal organs and tissues are discussed. Much attention is given to the long-term sequelae and effects of low doses of the radionuclide. There is discussion of the principles involved in extrapolating experimental data from animals to man, and recommendations are offered concerning the permissible levels of transuranium elements in the human body, water, and air of industrial premises.

PLANTS

REFER ALSO TO CITATION(S) 6180

6244 (LA-UR—79-3045) **Uptake of trace elements and radionuclides from uranium mill tailings by four-wing saltbush (Atriplex canescens) and alkali sacaton (Sporobolus airoides).** Dreesen, D.R.; Marple, M.L. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 18p. (CONF-791140—1). Dep. NTIS, PC A02/MF A01.

From 2. symposium on uranium mill tailings management; Fort Collins, CO, USA (19 Nov 1979).

A greenhouse experiment was performed to determine the uptake of trace elements and radionuclides from uranium mill tailings by native plant species. Four-wing saltbush and alkali sacaton were grown in alkaline tailings covered with soil and in soil alone as controls. The tailings material was highly enriched in Ra-226, Mo, U, Se, V, and As compared with three local soils. The shrub grown in tailings had elevated concentrations of Mo, Se, Ra-226, U, As, and Na compared with the controls. Alkali sacaton contained high concentrations of Mo, Se, Ra-226, and Ni when grown on tailings. Molybdenum and selenium concentrations in plants grown in tailings are above levels reported to be toxic to grazing animals. These results indicate that the bioavailability of Mo and Se in alkaline environments makes these elements among the most hazardous contaminants present in uranium mill wastes.

THERMAL EFFECTS

MICROORGANISMS

6245 (PB—289933) **Metabolic characteristics of the water column, benthos and integral community in the vicinity of Calvert Cliffs, Chesapeake Bay. Volume 1. Final report, January-December 1977.** Boynton, W.R.; Kemp, W.M.; Osborne, C.G.; Kaumeyer, K.R. (Maryland Univ., Solomons (USA). Chesapeake Biological Lab.). Oct 1978. 218p. NTIS PC A10/MF A01.

A field program was undertaken at the Calvert Cliffs Nuclear Plant to evaluate the effect on the benthic, water column, and

community metabolism. In addition, gross relationships between benthic metabolism, biomass, and numerical density were explored.

INVERTEBRATES

REFER ALSO TO CITATION(S) 6245

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 5344, 5345

6246 (ORNL/EMIC—10) **Chemical mutagenesis: a survey of the 1975-1976 literature.** Wassom, J.S.; Von Halle, E.S.; Whitfield, B.L. (Oak Ridge National Lab., TN (USA)). Oct 1979. Contract W-7405-ENG-26. 370p. Dep. NTIS, PC A16/MF A01.

This 1975 to 1976 bibliography has been compiled as part of a continuing effort to provide the scientific community with ready access to literature in the field of environmental mutagenesis. It contains references to articles published between 1969 and 1975 which have not appeared in previous EMIC surveys and references from the 1976 literature. Information contained in this survey is organized into seven indexes-citation, agent, Chemical Abstracts Service registry number, taxonomic, test object, author, and cell type. In each index terms are followed by EMIC accession numbers which refer the user back to references in the citation index. The keyword-in-context (KWIC) index of titles is available on microfiche only. Persons requiring current or comprehensive literature searches may access the EMIC data base on either the international on-line computer system TOXLINE or the national on-line system RECON. TOXLINE is a collection of toxicology data files sponsored and maintained by the National Library of Medicine and RECON is a system of data files sponsored by the Department of Energy. (ERB)

CELLS

REFER ALSO TO CITATION(S) 6206, 6211, 6232

6247 (DOE/EV/04472—2) **Relationship of DNA repair processes to mutagenesis and carcinogenesis in mammalian cells. Progress report, November 1, 1978-October 31, 1979.** Evans, H.H. (Case Western Reserve Univ., Cleveland, OH (USA)). Oct 1979. Contract EE-77-S-02-4472. 15p. Dep. NTIS, PC A02/MF A01.

The objective of this research is to determine the role of DNA repair in mutagenesis and carcinogenesis in mammlian cells. Repair capabilities will be varied by: (1) using wild-type and repair-deficient cell lines; (2) imposing various recovery periods following mutagenic treatment; (3) exposing cells to inhibitors of DNA repair following mutagenic treatment; and (4) varying the mutagenic treatment to cause DNA lesions repairable by different pathways. Reconstruction experiments were conducted to (1) investigate conditions for measuring transformation frequency using colony formation, and (2) determine the influence of ouabain-sensitive cells on the expression of ouabain-resistance. Ouabain-resistant cells were isolated from EMS-treated cultures and were shown to be resistant to the drug with regard to survival and the activity of the Na^+-K^+-ATPase. The effect of holding EMS-treated cells under various conditions which do not allow DNA synthesis was determined with respect to survival and the incidence of transformation and mutation. When confluent cells were held for 4 hrs following EMS treatment, both survival and the frequency of transformation increased. When the cells were incubated in 0.1% serum for 6 hrs following EMS treatment, no change in either the transformation or mutation frequency was observed as compared to cells incubated in 10% serum. Further experiments are in progress to determine the effect of recovery periods on transformation and mutation frequencies.

PLANTS

6248 (NTIS/PS—79/0354) **Air pollution effects on plants. Volume 2. April, 1976-March, 1979 (Citations from the NTIS Data Base). Report for April 1976-March 1979.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 112p. NTIS, PC AN01/MF N01.

The bibliography cites abstracts which are concerned with the effects of combustion products, industrial and automotive emissions on vegetation, forestry, and agricultural crops. Also included are plant responses when exposed to different levels of ozone. (Contains 206 abstracts)

6249 (NTIS/PS—79/0355) **Air pollution effects on plants (Citations from the American Petroleum Institute DAta Base).** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Apr 1979. 212p. NTIS, PC AN01/MF N01.

The bibliography presents a compilation of abstracts which deal with the effects of combustion products, industrial and automotive emissions on vegetation, forestry, and agricultural crops. Studies are also included relative to sink and emission factors for air pollutants. (This updated bibliography contains 105 abstracts, 32 of which are new entries to the previous edition.)

6250 (ORNL/EIS—155(Vol.1)) **Chemicals tested for phytotoxicity.** Ross, R.H.; Kemp, H.T.; Ryon, M.G.; Hammons, A.S.; Ensminger, J.T. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 1174p. Dep. NTIS, PC A99/MF A01.

Volume 1 of this 2 volume series is a catalog of chemicals which have been tested for phytotoxicity during the period 1920 to 1978. Coverage is restricted, by recent decision, to organic chemicals. However, those inorganic chemicals tested before the decision are retained. Entries are arranged alphabetically by chemical name. Included with each entry are the plants tested, chemical dose and formulation, experimental conditions, results, appropriate comments, and reference to the source of the information. (ERB)

6251 (ORNL/EIS—155(Vol.2)) **Chemicals tested for phytotoxicity.** Ross, R.H.; Kemp, H.T.; Ryon, M.G.; Hammons, A.S.; Ensminger, J.T. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 1044p. Dep. NTIS, PC A99/MF A01.

Volume 2 of this two-volume series is an index listing the chemicals and plants tested and the phytotoxic effects observed. The indexes included in this volume are: chemical name: chemical common name; plant common name; plant scientific name; references; chemical hierarchy; plant hierarchy; and effect hierarchy. (ERB)

INVERTEBRATES

REFER ALSO TO CITATION(S) 6183

6252 (PB—291211) **Environmental effects of western coal combustion. Part 2. The aquatic macroinvertebrates of Rosebud Creek, Montana. Final report.** Baril, S.F.; Luedtke, R.J.; Roemhild, G.R. (Montana State Univ., Bozeman (USA)). Nov 1978. 87p. NTIS PC A05/MF A01.

The aquatic macroinvertebrates of Rosebud Creek, Montana, were sampled between February 1976 and March 1977 to provide data on their abundance, distribution, and diversity. The sampling program was initiated during the first year of operation of the coal-fired power plants located at Colstrip, Montana. The purpose of the study was to determine if any immediate impacts of the power plant operation on the macroinvertebrate communities of Rosebud Creek could be detected and to provide data for comparisons with future studies. Rosebud Creek supported a diverse bottom fauna with high population numbers composed of species adapted to the turbid, silty conditions which are common in the prairie streams of eastern Montana. Intact riparian vegetation appeared to be important in maintaining stream bank stability and provided an essential food source.

VERTEBRATES

REFER ALSO TO CITATION(S) 5367, 6181, 6182, 6237

6253 (CONF-791090—2) **Laboratory studies of biological effects of sulfur oxides.** Dalbey, W.E. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

From Symposium on potential environmental and health effects of atmospheric sulfur deposition; Gatlinburg, TN, USA (14 Oct 1979).

Selected results from exposures of laboratory animals to airborne sulfur oxides were briefly summarized. The main observation during acute exposures was reflex bronchoconstriction and a resultant increase in pulmonary resistance. The increase in resistance due to sulfur dioxide (SO_2) was potentiated by simultaneous exposure to aerosols under conditions which would increase the transfer of sulfur oxides into the respiratory tract and promote transformation to a higher oxidation state, especially one that is acid. Sulfate aerosols, particularly sulfuric acid aerosols, were more potent than SO_2 in causing bronchoconstriction. Chronic exposure to high concentrations (400 to 650 ppM) of SO_2 resulted in experimental bronchitis in several species. Longterm exposure to more realistic concentrations of SO_2 produced little or no changes in respiratory function or morphology. Significant alterations in both pulmonary function and morphology have been reported after chronic exposure to sulfuric acid aerosols. Recent data indicate that changes in the lung may progress after cessation of such exposures.

6254 (PB—290728) **Pollutants in marine mammals: a literature review and recommendations for research. Final report.** Risebrough, R.W. (California Univ., Berkeley (USA). Bodega Bay Inst. of Pollution Ecology). 23 Nov 1978. Contract MM7AD035. 70p. NTIS PC A04/MF A01.

A review of the published literature and of selected unpublished data on the distributions and concentrations of pollutants in marine mammals has shown that all marine mammal populations are now exposed to a certain level of anthropogenic chemicals. Relationships, however, between observed pollutant levels and documented effects have remained difficult to prove. The pollutants include petroleum and petroleum-derived compounds, radioactive isotopes, certain trace elements and heavy metals, and synthetic organic compounds, particularly chlorinated hydrocarbons. The present data base is inadequate to show whether those petroleum compounds that may be present in seawater and filter-feeding organisms are sufficiently persistent to accumulate in marine mammal tissues. Mortality of individuals of those species which depend on their pelage for thermoregulation can be expected to occur in the event of oil spills.

6255 Pulmonary clearance and hilar lymph node content in rats after particle exposure. Ferin, J.; Feldstein, M.L. (Univ. of Rochester, NY). *Environ. Res.;* **16**: 342-352(1978).

The alveolo-bronchial and the lymphatic pathways are most important in pulmonary clearance of relatively insoluble particles. We were interested in studying the effect of the lung burden on the size of the fraction cleared via the lymphatic system. TiO_2 particles, representing the "inert and insoluble" class of particulate matter, were used in rats utilizing both intratracheal instillation and inhalation exposures. After a single exposure about 40 to 45% of the deposited particles are cleared from the lung in 25 days and about 0.7% are found in the hilar lymph nodes at low exposures. At high exposures lung clearance decreases, in some experiments to zero values, and the lymph node content increases to 4%. At low exposures both exposure techniques result in similar clearance values; however, the lymphatic node content rises with increased lung burden faster after intratracheal instillation. The possible mechanisms involved are discussed.

MAN

REFER ALSO TO CITATION(S) 6155

6256 (PB—292995) **Commuter exposure modeling methodologies. Final report September 1977-October 1978.** Simmon, P.B.; Patterson, R.M. (SRI International, Menlo Park, CA (USA)). Feb 1979. Contract EPA-68-02-2754. 168p. NTIS, PC AA08/MF A01.

Two methodologies for modeling commuter exposures are proposed: computer-oriented approach and a manual approach. Both modeling methodologies require that major commuter routes, or pathways, be identified and that the traffic on the remainder of the roadway network be treated as background pollutant sources. Since the majority of pathway exposure is expected to result from emissions on the pathway itself, the emissions and dispersion of nonpathway source pollutant are handled in a simple fashion. Pathway traffic undergoes a more sophisticated treatment in that congestion and delay due to signalization are accounted for and emissions are computed accordingly. The methodology used to simulate the dispersion of pathway emissions utilizes three separate dispersion treatments, according to whether the roadway is limited-access, nonlimited access, or a street canyon.

HEALTH AND SAFETY

6257 (SAND—79-1812) **Audit/appraisal guidelines for organizational ES and H assurance programs.** Ellingson, A.C. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 98p. Dep. NTIS, PC A05/MF A01.

A program standard applicable to environment, safety, and health (ES and H) concerns has been tested and previously reported. One of the features of the standard is an audit/appraisal system for ES and H program evaluation. Guidelines for audition or appraising ES and H assurance programs are presented. The discussion is organized under seven topics: the audit/appraisal function; the audit team; audit planning; use of sampling in audit/appraisals; evidence collection and evaluation; reporting; and follow-up. The first appendix is devoted to the standard for ES and H assurance programs. The other appendixes are entitled: standard ES and H audit checklist and its application; element rating guide; and audit plan.

6258 (SAND—79-1967) **Special Projects Division quarterly report of progress, 1 July through 30 September 1979.** (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 26p. Dep. NTIS, PC A03/MF A01.

Primary effort in the area of methods development was placed on the development of audit/appraisal guidelines for an environment, safety, and health (ES and H) assurance program. A draft document was completed and circulated for comments, some of which have been incorporated in the final version. Techniques for assuring the implementation of an ES and H program were addressed. Program elements to be examined are outlined. Considerable effort was expended in developing the details of program performance necessary for the design of an information system that will provide the necessary data for ES and H assurance and appraisals. (JGB)

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 5454

6259 (SAND—79-1519) **Laboratory studies of water transport in rock salt.** Hohlfelder, J.J.; Hadley, G.R. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

The transport of water through rock salt as a result of heating is examined experimentally and a new model proposed to explain the data. The experiment consists of the measurement of water loss rate as a function of time for three 1 kg blocks of Southeastern New Mexico rock salt. Each block was heated for approximately three days with maximum temperatures ranging from 165 to 250°C. The resulting data is qualitatively explained by a continuum model of Darcian flow of water vapor from a receding evaporation front. The model includes the prediction of thermal stresses which are calculated to crack the specimens during heater shutdown giving an anomalously high water loss spike in agreement with the data.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

6260 (EPRI-NP—1091(Vols.1-3)) **Applications in soil-structure interactions. Final report, June 1979.** Jhaveri, D.P. (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA)). 1979. 304p. Dep. NTIS, PC A14/MF A01.

Complex phenomenon of soil-structure interaction was assessed. Relationships between the characteristics of the earthquake ground motions, the local soil and geologic conditions, and the response of the structures to the ground motions were studied. (I) The use of the explicit finite-difference method to study linear elastic soil-structure interaction is described. A linear two-dimensional study of different conditions that influence the dynamic compliance and scattering properties of foundations is presented. (II) The FLUSH computer code was used to compute the soil-structure interaction during SIMQUAKE 1B, an experimental underground blast excitation of a 1/12-scale model of a nuclear containment structure. Evaluation was performed using transient excitation, applied to a finite-difference grid. Dynamic foundation properties were studied. Results indicate that the orientation and location of the source relative to the site and the wave environment at the site may be important parameters to be considered. Differences between the computed and experimental recorded responses are indicated, and reasons for the discrepancy are suggested. (III) A case study that examined structural and ground response data tabulated and catalogued from tests at the Nevada Test Site for its applicability to the soil-structure interaction questions of interest is presented. Description, methods, and evaluation of data on soil-structure interaction from forced vibration tests are presented. A two-dimensional finite-difference grid representing a relatively rigid structure resting on uniform ground was analyzed and monitored. Fourier spectra of monitored time histories were also evaluated and are presented. Results show clear evidence of soil-structure interaction and significant agreement with theory. 128 figures, 18 tables.

GEOPHYSICAL SURVEY METHODS

6261 (RHO-SA—59) **Evaluation of dike-flow correlations indicated by geochemistry, Chief Joseph Swarm, Columbia River basalt.** Price, S.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1978. Contract EY-77-C-06-1030. 347p. Dep. NTIS, PC A15/MF A01.

Thesis. Submitted to Univ. of Idaho, Moscow.

A geochemical examination of dikes of a part of the Chief Joseph swarm, southeastern Washington-northeastern Oregon, and proximate Columbia River Basalt flows was conducted to evaluate the reliability of using comparative geochemistry to establish dike-flow correlations. An initial assessment of chemical variation, based on the major, minor, and selected trace element analyses of 48 dikes of the Grande Ronde River-Joseph Creek area (formerly known as the Grande Ronde swarm), revealed that although intradike chemical variation is minimal, interdike chemical variation is significant.

Of the dikes surveyed, 32 are of Yakima chemical type, eight of Dodge chemical type, one of Roza chemical type, one of Umatilla chemical type, five of Pomona chemical type, and one of Lolo chemical type (chemical type nomenclature of Wright and others, 1973; Swanson and others, 1977).

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 5398, 5459, 5465

6262 (RHO-BWI-C—54) **Determination of basalt physical and thermal properties at varying temperatures, pressures, and moisture contents. Second progress report, fiscal year 1979.** Miller, R.J. (Colorado School of Mines, Golden (USA). Evacuation Engineering and Earth Mechanics Inst.). 13 Aug 1979. Contract EY-77-C-06-1030. 80p. Dep. NTIS, PC A05/MF A01.

The rock mechanics testing performed at the Earth Mechanics Institute of the Colorado School of Mines for Rockwell Hanford Operations under Subcontract SA-917 is summarized. Cores were supplied from drill hole DC-8 on the Hanford Site, characterized geologically, and tested for thermal and physical properties for designing long-term underground storage of radioactive waste materials. This report presents the approved test procedures, results, and data analysis for this test series. Results indicate significantly lower strengths for drill hole DC-8 than determined for drill hole DC-6 or for the drill holes reported on in our fiscal year 1978 (FY 78) tests. Trends, however, were found to be similar between drill holes DC-6 and DC-8, and it is hoped more definitive conclusions can be found following completion of the final series of tests.

6263 (RHO-BWI-C—55) **Determination of basalt physical and thermal properties at varying temperatures, pressures, and moisture contents. Third progress report, fiscal year 1979.** Miller, R.J. (Colorado School of Mines, Golden (USA). Evacuation Engineering and Earth Mechanics Inst.). 31 Aug 1979. Contract EY-77-C-06-1030. 82p. Dep. NTIS, PC A05/MF A01.

The rock mechanics testing performed at the Earth Mechanics Institute of the Colorado School of Mines for Rockwell Hanford Operations under subcontract SA-917 is summarized. Cores were supplied from drill hole DC-4 on the Hanford Site, characterized geologically, and tested for thermal and physical properties for designing long-term underground storage of radioactive waste materials. The approved test procedures, results, and data analysis for this test series are presented. Uniaxial and triaxial results indicate strengths similar to drill hole DC-6, but significantly higher than drill hole DC-8. Trends with density, depth, confining pressure, and temperature, however, were similar for the three drill hole locations tested.

6264 (SAND—79-1853) **Constitutive model for the low temperature creep of salt (with application to WIPP).** Munson, D.E.; Dawson, P.R. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 47p. Dep. NTIS, PC A03/MF A01.

While numerous constitutive models have been proposed for the low temperature creep of salt, this work is the first to develop such a model within the framework of rate controlling mechanisms and the deformation-mechanism map. Use of this framework permitted unfolding of the rather complicated low temperature steady-state creep behavior into three simpler responses involving separate regimes with individual controlling mechanisms. The observed total creep rate obeys the rules of additive processes. The creep model incorporates primary (transient) creep as a simple two parameter modificaton to the steady-state creep equations. Application of the model is through a formulation into proper stress and strain measures for use in a large strain finite element code. Extensive analysis of available low-temperature triaxial creep data produced the appropriate material parameters, including activation energies and stress dependencies for the separate regimes. Material variations were observed to produce changes in absolute creep rate, without change in controlling mechanism. Numerous calculations demonstrate the adequacy of the model and numerical method to simulate the results of triaxial creep experiments on Southeastern New Mexico salt from the horizons proposed for the Waste Isolation Pilot Plant (WIPP).

6265 (SAND—79-2028C) **Apparatus effects in the determination of strength variation in anisotropic rock.** Donath, F.A.; Schuler, K.W.; Tillerson, J.R. (Sandia Labs., Albuquerque, NM (USA); Illinois Univ., Urbana (USA)). 1979. Contract EY-76-C-04-0789. 21p. (CONF-7906139—1). Dep. NTIS, PC A02/MF A01.

From Euromech colloquium 115 mechanical behavior of anisotropic solids; Grenoble, France (19 Jun 1979).

Some experimental results and theoretical calculations of strength variation in anisotropic rock are reviewed and discussed along with the results of a finite element analysis of apparatus effects. Highly nonuniform stress distributions can be imposed on test samples by apparatus constraints; it is concluded that stress distributions leading to failure in anisotropic rock are particularly affected by the anisotropy orientation, lubrication of end surfaces, and constraints on the loading piston of the test apparatus. Neglect of these factors by the investigator might result in the determination of unrepresentative values of strength parameters for the material being tested.

6266 (SAND—79-7030) **Creep behavior of bedded salt from southeastern New Mexico at elevated temperature.** Hansen, F.D.; Mellegard, K.D. (RE/SPEC, Inc., Rapid City, SD (USA)). Nov 1979. Contract EY-76-C-04-0789. 126p. Dep. NTIS, PC A07/MF A01.

Results of a series of triaxial creep experiments conducted on bedded salt specimens from ERDA Hole 9 in southeastern New Mexico are presented. The purpose of the experiments was to measure creep response of salt at temperatures of 24, 70, and 100°C under confinement pressures of 0, 1500, 2000, 2500, and 3000 psi and differential axial stress levles of 1500, 3000, 4500, and 6000 psi. Test durations ranged from 15 minutes to over 500 hours. The specimens, obtained by recording 4-in.-dia cores in the axial direction, were nominally two inches in diameter and four inches in length. The crystal size ranged from very small to one-half inch diameter; the specimens contained various amounts of clay impurities. A total of 19 specimens were prepared of which 14 were tested. The collected data included axial and lateral strain, axial and confinement stresses, time and temperature. Periodically, axial stress was adjusted to account for specimen strain in order to maintain a constant differential stress. Frequency of the stress correction was dependent on the rate of deformation; two or more corrections in a 24-hour period were typical. Data were automatically recorded with a printer, manually recoded from the print-out to punched cards and reduced by means of a computer. A preponderance of the data was collected in the transient creep regime. In some tests specimen rupture occurred, while in others an accelerating creep rate brought the specimen in contact with the pressure vessel wall. Aslo, a considerable amount of data was collected during stress application to creep stress level.

6267 (SAND—79-7045) **Triaxial quasi-static compression and creep behavior of bedded salt from southeastern New Mexico.** Hansen, F.D. (RE/SPEC, Inc., Rapid City, SD (USA)). Nov 1979. Contract EY-76-C-04-0789. 131p. Dep. NTIS, PC A07/MF A01.

This report summarizes the results obtained from a series of triaxial quasi-static compression and creep tests on specimens of bedded salt recovered at depth intervals of 1953 to 1954 and 2711 to 2722 feet in AEC Hole No. 7 in southeastern New Mexico. The primary objective was the determination of the deformational characteristics of the salt for prescribed stress and temperature states under quasi-static and time-dependent conditions. The test conditions encompassed confining pressures of 500 and 2000 psi, differential axial stresses of 1500, 3000 and 4500 psi, temperatures of 23 and 100°C, and time durations of several hours to ten days. The data analysis was confined primarily to power law fits to the creep strain-time measurements and to an evaluation of the principal strain ratio behavior for the various test conditions and axial strain magnitudes.

6268 (UCID—18289) **Numerical modeling of spall phenomena.** Burton, D.E.; Bryan, J.B.; Lettis, L.A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. 36p. Dep. NTIS, PC A03/MF A01.

Pitfalls commonly encountered in numerically modeling spall phenomena with finite difference computer codes are discussed. Three purely numerical problems (zone size effects, continuous rezoning, and hourglass damping) and three constitutive problems (artificial viscosity, tensile failure, and void closure) are considered. This paper gives three examples of numerically calculated spall: a controlled blasting configuration, a recalculation of the Sedan cratering event, and a simulation of the Baneberry event. 20 figures.

6269 **Microcracking and healing in granites: new evidence from cathodoluminescence.** Sprunt, E.S.; Nur, A. (Stanford Univ., CA). *Science;* **205**: 495-497(3 Aug 1979).

Quartz grains in granitic rocks usually have blue cathodoluminescence (CL). Within the blue-luminescing grains, there are often red-luminescing domains which are frequently impossible to detect without CL contrast. This finding suggests that the red-luminescing quartz is sealing preexisting microcrcks. The presence of these now-healed microcracks has important implications with respect to the role of pore fluid pressure and fluid transfer in metamorphism, the origin of granites, long-period crustal deformation, earthquake mechanics, physical properties of rocks, and deep-seated geothermal energy. 1 figure, 1 table

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 6261

PHYSICS RESEARCH

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

6270 (AD-A—064752) **Auroral electron fluxes. Final report, 1 April 1977-1 February 1978.** Sharp, W.E. (Michigan Univ., Ann Arbor (USA). Space Physics Research Lab.). Nov 1978. 20p. NTIS, PC AA02/MF A01.

The data analyzed were from an auroral rocket probe, AF 10.312, launched in 1974 from Poker Flats, Alaska. The instrumentation is described in an AF Geophysics Laboratory Technical Report AFCRL-TR-75-0023. The data were from both a low energy and high energy electron spectrometer, which measured fluxes at 1-100 eV and 1-20 keV respectively. The rocket flight was north along a geomagnetic meridian, crossing the Harang discontinuity and several non optical auroral arcs. Data represents the first available electron flux measurements over such an extensive energy range (1eV to 20 keV) at an instant of time and for a number of altitudes. The flux distribution to the south of the discontinuity showed two 'bumps', one at 5eV and the other at 4keV due to a lack of loss mechanisms at the lower energy and by the monoenergetic flux from space for the higher. The fluxes generally decreased with decreasing altitude as expected. No pitch angle dependence was discovered. South of the discontinuity peak fluxes were centered on 2keV. An order of magnitude increase in flux at energies less than 10keV were measured while the discontinuity was crossed (rocket was at 165 km). In the auroral arcs, the peak flux was at 7KeV. Wave particle interactions were interpreted as the cause for the pattern of change with altitude of the greater than 1keV and less than 10eV fluxes. (Author)

6271 (LA—7984-MS) **Review of ionospheric disturbances resulting from some naturally occurring events.** Hoffman, M.M. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

Some known and some potential sources of atmospheric disturbances have been investigated in a review of scientific papers selected to illustrate the roles of naturally occurring phenomena in generating observable ionospheric effects. Reports of acoustic and ionospheric effects resulting from the Alaskan earthquake of 1964 are used as a guide to the nature of signals generated by all seisms. Scaling these effects to smaller seisms is considered. Some models for enhanced acoustic coupling between the earth and atmosphere are discussed. Investigations of signals generated within the atmosphere by meteorological events are also reviewed.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 6100

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 6116, 6121

6272 (CONF-790843—10) **Determination of molecular-ion structures through studies of the collisionally-induced dissociation of fast (MeV) molecular ions.** Gemmell, D.S.; Cooney, P.J.; Kanter, E.P. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

High-resolution studies of the angle and energy distributions of fragments detected in coincidence from the foil- and gas-induced dissociation of fast (MeV) polyatomic molecular ions are described. The aim of the measurements is to explore the possibilities that these new techniques offer for determining the stereochemistry of molecular ions.

6273 (COO—3158-80) **Sputtering of tungsten: an atomic view of a near-surface depleted zone created by a single 30 keV $^{63}Cu^{+}$ projectile. Report No. 4118.** Current, M.I.; Seidman, D.N. (Cornell Univ., Ithaca, NY (USA). Materials Science Center). 1979. Contract EY-76-S-02-3158. 14p. (CONF-790843—11). Dep. NTIS, PC A01/MF A01.

From 8. international conference on atomic collisions in solids; Hamilton, Canada (13 Aug 1979).

The vacancy structure of a near-surface depleted zone (DZ), created by a single 30 keV $^{63}Cu^{+}$ ion in a tungsten field-ion microscope (FIM) specimen, was determined with atomic resolution. Both the irradiation and pulse field-evaporation experiments were performed in situ at $\leqq$ 11 K, so that the observed vacancy structure was unaltered by the long-range migration of self-interstitial atoms. The following basic physical quantities were measured: (1) the number of vacancies; (2) the dimensions; (3) the vacancy concentration; (4) the distribution of first-nearest-neighbor vacancy clusters; and (5) the radial-distribution function for the vacancies out to ninth-nearest neighbor. The values of these quantities were shown to be similar for both the near-surface DZ and DZs created in the bulk of the same specimen by 30 keV $^{63}Cu^{+}$ projectiles.

6274 (UCRL-Trans—1582) **Present status of research on electron guns and the confinement solenoid permitting the definition of the parameters of CRYEBIS.** Goldstein, C.; Ulrich, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Aug 1979. Translation of IPNO—75-08, Jun 1975. 22p. Dep. NTIS, PC A02/MF A01.

Present studies and limitations of the SILFEC 1 source show a certain number of requirements on the solenoid to be constructed for the CRYEBIS source, which must permit, on the one hand, the acceleration of light ions at a low repetition rate, and on the other hand, the ionization and storage of polarized protons. It is not the intention to return to the basic operation of the source, already discussed elsewhere, or to certain elements of the CRYEBIS project. What can be used as the basic data of the present project is determined by summarizing the research in progress on guns and on the confinement solenoid, and on the other hand, what is required to permit future developments over the short and medium term.

6275 **Addendum: on the influence of void compaction and material non-uniformity on the propagation of one-dimensional acceleration waves in granular materials.** Nunziato, J.W.; Walsh, E.K. (Sandia Laboratories, Albuquerque, NM). *Arch. Ration. Mech. Anal.;* **67**: No. 4, 395-398(1978).

Further refinement of the mathematical treatment of results on acceleration waves to a particular granular material previously published by the author are reported. A few corrections to the original paper are also indicated. The refined mathematical treatment led to the conclusion that across a shock wave in material with an initially uniform distribution of granules, the discontinuity of the volume distribution function ν is second order.

ATOMIC AND MOLECULAR PROPERTIES

6276 (COO—1198-1268) **Studies in the electronic structure of matter.** Swarts, C.A. (Illinois Univ., Urbana (USA). Graduate Coll.). 1979. Contract EY-76-C-02-1198. 350p. Dep. NTIS, PC A15/MF A01.

Thesis.

The results of various theories for the angular distribution of electrons photoemitted from the outermost p-shell of rare gas atoms are compared. The theories compared are the local density theories of Slater (X/sub α/) and of Hohenberg, Kohn and Sham, the pseudopotential method, Hartree-Fock theory as evaluated by Kennedy and Manson, and Amusia's random phase approximation with exchange (RPAE). Extended Huekel theory is applied to GaAs, GaP, and to the nitrogen isoelectronic trap in GaAs and GaP. The computer perfect crystal band structures are found to be in reasonable agreement with those computed with empirical pseudopotentials. Nitrogen impurity levels in GaAs and GaP are calculated using a cluster model. By means of model calculations for an independent electron metal, exact lineshapes are obtained for the photon absorption, emission and photoemission spectra of deep core states. 97 references.

6277 (COO—1198-1278) **High pressure photophysics of organic molecules.** Brey, L.A. (Illinois Univ., Urbana (USA). Graduate Coll.). 1979. Contract EY-76-C-02-1198. 105p. Dep. NTIS, PC A06/MF A01.

Thesis.

High pressure spectroscopic studies on several classes of organic compounds were made both in fluid solution (to 10 kbar) and in polymeric media (to 40 kbar). The first three studies were conducted in fluid solution and concern the effect of solvent viscosity on the nonradiative deactivation rates from electronically excited states. Pressure was utilized to attain high viscosities in organic solvents at room temperature. The primary experimental technique used was fluorescence emission spectroscopy. In the fourth and last study observations were made both in fluid solution and in plastic films. The focus of this study was the effect of pressure on the solvent-chromophore dispersion interaction in several polyenes and the concomitant changes in both the radiative and non-radiative rates from the excited states. Extensive use was made of fluorescence lifetime measurements and excitation spectra. 105 references.

6278 (LA-UR—79-2822) **Electron attachment rates in Cl_2.** Sze, R.C.; Greene, A.E.; Brau, C.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 14p. (CONF-791078—1). Dep. NTIS, PC A02/MF A01.

From 32. gaseous electronics conference; Anaheim, CA, USA (9 Oct 1979).

The measurement of electron attachment rates in Cl_2 is a continuing effort to obtain quantitative data on all possible halogen donor species that may be relevant to the rare gas halide discharge lasers. These rates are obtained by measuring the decay of the current signal when a constant voltage is applied across the electrodes. A typical decay curve is given. Attachment rates are measured in nitrogen and argon mixtures in order to access different regions of mean electron energies. Attachment rates as a function of E/N in argon for the same fractional chlorine concentration as in the case of nitrogen are shown. These two sets of data are plotted together as a function of mean electron energy. The mean electron energy is obtained for each E/N. The plot of attachment rate as a function of mean electron energy is also given. 5 references. (JFP)

6279 (LBL—10021) **Laser induced fluorescence of trapped molecular ions.** Grieman, F.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 255p. Dep. NTIS, PC A12/MF A01.

Thesis.

An experimental apparatus for obtaining the optical spectra of molecular ions is described. The experimental technique includes the use of three dimensional ion trapping, laser induced fluorescence, and gated photon counting methods. The ions, which are produced by electron impact, are confined in a radio-frequency quadrupole ion trap of cylindrical design. Because the quadrupole ion trap allows mass selection of the molecular ion desired for study, the analysis of the spectra obtained is greatly simplified. The ion trap also confines the ions to a region easily probed by a laser beam. 18 references.

6280 (PB—289815) **Bibliography on atomic line shapes and shifts (June 1975 through June 1978). Interim report.** Fuhr, J.R.; Miller, B.J.; Martin, G.A. (National Measurement Lab. (NBS), Washington, DC (USA)). Dec 1978. 86p. NTIS PC A05/MF A01.

This is the third supplement to the NBS Special Publication 366, Bibliography on Atomic Line Shapes and Shifts (1889 through March 1972). It contains about 600 references and covers the literature from June 1975 through June 1978. As before, the bibliography contains five major parts: (1) All general interest papers are catalogued according to the broadening mechanisms (and, further, according to special topics under several of the mechanisms) and as to whether the work is a general theory, a general review, a table of profiles or parameters, a comment on existing work, a study of general experimental measurement techniques, or an experimental effort of general importance. Also included are selected papers on important applications of line broadening and on miscellaneous topics relating to atomic spectral line shapes and shifts. (2) In Part 2 all papers containing numerical data are ordered as to element, ionization stage, and broadening mechanism (in the case of foreign gas broadening the perturbing species are listed), and it is indicated whether the data are experimentally or theoretically derived. (3) While in the two preceding parts of the bibliography the references are listed for brevity by identification numbers only, in Part 3 all references are listed completely by journal, authors, and title and are generally arranged by year of publication and alphabetically by authors' names within the year. (4) This section contains a list of all authors and their papers. (5) A final section provides corrections or additions to the second supplement to the original bibliography.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 6330

6281 (ANL/PHY—79-3) **Physics with fast molecular-ion beams. Proceedings of workshop held at Argonne National Laboratory, August 20-21, 1979.** Gemmell, D.S. (ed.). (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 348p. Dep. NTIS, PC A15/MF A01.

The Workshop on Physics with Fast Molecular-Ion Beams was held in the Physics Division, Argonne National Laboratory on August 20 and 21, 1979. The meeting brought together representatives from several groups studying the interactions of fast (MeV) molecular-ion beams with matter. By keeping the Workshop program sharply focussed on current work related to the interactions of fast molecular ions, it was made possible for the participants to engage in vigorous and detailed discussions concerning such specialized topics as molecular-ion dissociation and transmission, wake effects, ionic charge states, cluster stopping powers, beam-foil spectroscopy, electron-emissions studies with molecular-ion beams, and molecular-ion structure determinations.

6282 (COO—2203-7-T1) **Critical scattering of laser light by fluid films and interfaces.** Mockler, R.C.; O'Sullivan, W. (Colorado Univ., Boulder (USA)). Oct 1979. Contract EY-76-S-02-2203. 16p. Dep. NTIS, PC A02/MF A01.

Analysis of results of coexistence curve measurements for films of a 2,6-lutidine + water critical mixture, has resulted in the first general confirmation of the scaling theory description of Ising class fluid film critical behavior. For example, we have shown that (3,1) to (2,1) universality class transitions occur in these films as a result of finite size constraints upon the evolution of the correlation length, ξ. There exists a generalized law of corresponding states for films. The critical temperature-shift exponent and the crossover temperature critical exponent agree with the values predicted by scaling theory. The 2D regime coexistence curve amplitude dependence upon film thickness is consistent with scaling theory. There exists an unanticipated interaction between the fluid films and the interferometer mirrors in contact with them. This is manifested in a uniform, film thickness dependent, displacement of the entire coexistence curve structure in temperature. We have completed construction of an ellipsometer to be used in studies of the interface between a solid surface and a critical fluid. In addition, we have assembled, and are currently evaluating, a system for studying the intensity autocorrelation of light scattered from critical fluid films. Progress has been made toward developing mathematical techniques for analyzing nonexponential correlation functions in terms of expansions in orthogonal polynomials.

6283 (LBL—9838) **Molecular beam photoionization and gas-surface scattering.** Ceyer, S.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 244p. Dep. NTIS, PC A11/MF A01.

Thesis.

The energetics of the ethylene ion-molecule reactions was investigated in more detail than previously possible in two body collision experiments by photoionization of the neutral van der Waals ethylene dimer. The stability of the $(C_2H_4)^+C_2H_4$ ion-molecule collision complex has been determined to be 18.2 +- 0.5 kcal. The highest potential barriers along the reaction coordinate for decomposition of this collision complex into $C_4H_7^+ + H$ and $C_3H_5^+ + CH_3$ have been determined to be 0 +- 1.5 and 8.7 +- 1.5 kcal. In a similar manner, the energetics of the solvated ethylene dimer ion was investigated by the photoionization of the ethylene trimer. The absolute proton affinity of NH_3 (203.6 +- 1.3 kcal/mole) and the proton solvation energies by more than one NH_3 have been determined by molecular beam photoionization. In addition, the NH_3^+-NH_3 interaction energy (0.79 +- 0.05 eV) was measured by photoionization of the neutral van der Waals dimer. These experiments have shown that photoionization of van der Waals clusters is a very powerful method of determining the energetics of gas phase proton solvation. The scattering of helium atomic beams from a high Miller index platinum surface that exhibits ordered, periodic steps on the atomic scale to probe the effect of atomic steps on the scattering distribution is explored. Rainbow scattering is observed when the step edges are perpendicular to the incident helium atoms. The design, construction and operation of a beam-surface scattering apparatus are described. The first data obtained in this apparatus are presented and the interesting dynamical aspects of the oxidation of D, D_2 and CO are discussed. 75 references.

6284 (MLM—2661) **Algorithms and FORTRAN programs to calculate classical collision integrals for realistic intermolecular potentials.** Taylor, W.L. (Mound Facility, Miamisburg, OH (USA)). 29 Nov 1979. Contract EY-76-C-04-0053. 45p. Dep. NTIS, PC A03/MF A01.

Numerical methods and computer programs are given to evaluate, for an arbitrary intermolecular potential, the classical transport collision integrals which appear in the kinetic theory of dilute gases. The method of Gaussian quadrature was employed to integrate the triple integral. A detailed discussion is given of the mathematics necessary to determine the boundaries of the individual integrations as well as a detailed analysis of errors introduced by the numerical procedures. Results for a recently published helium potential, the HFDHE2, are given. 5 references.

ATOMIC AND MOLECULAR THEORY

6285 **Rotated coordinate method and its relation to the stabilization method.** Taylor, H.S. (Univ. of Southern California, Los Angeles). pp 25-44 of Physics of ionized gases. Janev, R.K. (ed.). Beograd, Yugoslavia; Institute of Physics (1978).

From 9. symposium on the physics of ionized gases; Dubrovnik, Yugoslavia (28 Aug 1978).

The rotated coordinate method (RCM) is discussed. The result of the discussion will be first to show that there is an efficient way to do rotated coordinate calculations of atomic resonances, and then to show that this procedure allows one to apply the RCM to the calculation of resolvents (such as photoionization cross sections) and to the calculation of electron-molecule resonances. Arguments indicate that the problem of slow convergence that has plagued analytic continuation methods may be partially or totally alleviated by the proposals presented herein. 25 references.

6286 (LA-UR—79-3144) **Ground states and magnetic responses of model valence-fluctuation systems.** Brandow, B.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-791142—4). Dep. NTIS, PC A02/MF A01.

From International Conference on crystal field and structural effects in f-electron systems; Philadelphia, PA, USA (12 Nov 1979).

Variational ground-state wavefunctions are presented and optimized for two model valence-fluctuation systems, based on Anderson lattice Hamiltonians in the U → ∞ limit. Although these wavefunctions are approximate, they are treated in an essentially exact manner. The [f^0,f^1; n = 1] system has an intuitively reasonable ground-state susceptibility, while the [f^1,f^2; n = 2] system is found to exhibit an insulating gap.

GENERAL FLUID DYNAMICS

6287 (COO—2557-T1) **Effects of finite size on the critical behavior of fluid films.** Scheibner, B.A. (Colorado Univ., Boulder (USA)). 1978. Contract EY-76-S-02-2557. 126p. Dep. NTIS, PC A07/MF A01.

Thesis.

This thesis presents the results of refractive index studies performed on films of a critical mixture of 2,6-lutidine+water near the lower critical point. The films ranged in thickness from 0.46 μm to ~ 300 μm and were confined between the highly reflecting surfaces of a pair of optical flats in an interferometer. Above the critical temperatures of these films, in the two-phase region, Δn was measured, the difference between the refractive indexes of the two phases. Since to a close approximation Δn is proportional to the order parameter, measurements of Δn as a function of temperature map out the coexistence curves of the films.

PROPERTIES AND STRUCTURE OF FLUIDS

REFER ALSO TO CITATION(S) 6268

HIGH ENERGY PHYSICS

6288 (ORO—3509-16) **Elementary particle physics. Progress report covering the five year period November 1, 1974 to October 31, 1979.** (Florida State Univ., Tallahassee (USA). Dept. of Physics). 1979. Contract EY-76-S-05-3509. 287p. Dep. NTIS, PC A13/MF A01.

Experimental and theoretical research in high energy physics is summarized. Preparations and proposals for future experiments include high mass states decaying into phiπ^{+-}, phi$\pi^{+-}\gamma$ and phiphi produced centrally in 300 GeV/c π^-p interactions, search for baryonium and for hyperonium, exotic states and charm decays, and dilepton production by neutrinos. A list of publications is included. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

REFER ALSO TO CITATION(S) 6126, 6296, 6299

6289 (SLAC-PUB—2432) **Parity violation in deep inelastic electron scattering.** Taylor, R.E. (Stanford Linear Accelerator Center, CA (USA)). Nov 1979. Contract EY-76-C-03-0515. 16p. (CONF-790610—6). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear physics with electromagnetic interactions; Mainz, F.R. Germany (5 Jun 1979).

Neutral currents in electron scattering and the Weinberg-Salam model are reviewed. This generally accepted model is consistent with experimental results from neutrino interactions; an appropriate deep inelastic electron scattering experiment would measure couplings that don't involve neutrinos to see if they are also correctly described by the theory. The SLAC-Yale experiment measures a difference in the e-d inelastic cross section for right- and left-handed electrons. The polarized source, beam monitors, scattering experiment, checks of helicity dependence, and results are described. It is concluded that the data obtained are in agreement with the Weinberg-Salam model, and that the best value of sin^{2}theta/sub W/ for these data is in excellent agreement with the average values of that parameter deduced from neutrino experiments. Future experiments with polarized electrons are discussed. 12 figures, 2 tables. (RWR)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 6296

6290 (COO—3000-T2) **Deep inelastic muon scattering at Fermilab.** Mugge, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1979. Contract EY-76-C-02-3000. 44p. Dep. NTIS, PC A03/MF A01.

As a second-generation Fermilab muon experiment, E203/391 was designed to have high sensitivity to any number of muons in the final state. This allowed a broad range of lepto-induced physics to be studied ranging from exotic 4- and 5-muon final states to deeply fundamental inelastic structure function measurements. The experimental apparatus and triggers are described along with the general scheme of the analysis. Next, a brief outline is given of some of the rich results of the multimuon final states to give a feeling for the apparatus performance and also a feeling for what to look forward to in the coming year. And, finally, a more detailed discussion of the early work on deep inelastic structure functions. 17 references.

6291 (COO—3130TC-1) **Research program in experimental high energy physics. Task C. Progress report, January 1, 1979-December 31, 1979.** Lanou, R.E. Jr. (Brown Univ., Providence, RI (USA)). 1 Oct 1979. Contract EY-76-C-02-3130. 62p. Dep. NTIS, PC A04/MF A01.

An experimental program in strong and weak interaction physics of elementary particles is being carried out using electronic detection techniques. Experiments have been performed or have been proposed utilizing the accelerators of the laboratories at Brookhaven, Fermilab, LAMPF, and SLAC. The experiments described by the Electronic Detector Group include the following: an analysis of resonances in the proton-antiproton system, a study of inclusive scattering in hadron reactions of the form a + p(n) → b + X, where a and b can be π+-, K+-, p+- in any combination at incident momenta up to 175 GeV/c, an experiment to measure neutrino-electron and other neutral current phenomena at the BNL-AGS, and development of a muon polarimeter and proposals for its use in further experiments. A list of publications is included.

6292 (UH—511-328-29) **Study of neutrino-produced dimuons using the Fermilab 15-foot bubble chamber and external muon identifier.** Peterson, V.Z. (Fermi National Accelerator Lab., Batavia, IL (USA); Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA)). Jan 1979. Contract EY-76-C-03-0511. 21p. Dep. NTIS, PC A02/MF A01.

Remarks are made about the motivation and techniques of neutrino experiments for dimuon production using large bubble chambers. Also described are two special features of the Fermilab 15-foot bubble chamber hybrid system: the external muon identified and the new internal picket fence. 21 references. (JFP)

6293 **Measurement of stopped π^+ decays in a copper beam dump with incident protons of 720 MeV. A calibration of the LAMPF neutrino source intensity.** Chen, H.H.; Lathrop, J.F.; Newman, R. (California Univ., Irvine (USA). Dept. of Physics); Evans, J.C. (Brookhaven National Lab., Upton, NY (USA)). *Nucl. Instrum. Methods;* **160**: No. 3, 393-405(1 Apr 1979).

The authors have measured the distribution and number of stopped π^+ decays in a copper beam dump per incident proton of 720 MeV. The decay of stopped π^+'s, and stopped μ^+s, produce neutrinos with well defined spectra. These spectra provide neutrinos which are utilized in neutrino experiments at LAMPF. The present measurement, therefore, calibrates the LAMPF neutrino source intensity. It is found that there are a total of 0.0571+-0.0035 stopped π^+ decays per incident 720 MeV proton.

6294 **Production of μe events in antineutrino-nucleon interactions.** Berge, J.P.; Bogert, D.; Endorf, R.; Hanft, R.; Hamilton, D.; Harigel, G.; Malko, J.A.; Moffatt, G.I.; Nezrick, F.A.; Smart, W. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Phys. Lett., B;* **81**: No. 1, 89-92(29 Jan 1979).

A clear observation of μ^+e^- events produced in an antineutrino heavy neon-hydrogen experiment using the Fermilab 15 ft bubble chamber is reported. The relative production rate, Vee yield, and scaling varible distributions are presented, and the events are interpreted as charmed particle production from ocean quarks.

6295 **Intra-nuclear cascading in deep inelastic scattering of 150 GeV muons in emulsion.** Hand, L.; Petersen, D.; Scott, H.; Gottfried. K. (Cornell Univ., Ithaca, NY (USA). Lab. of Nuclear Studies); Atac, M.; Read, A.L.; Voyvodic, L. (Fermi National Accelerator Lab., Batavia, IL (USA)); Czyz, W.; Furmanska, B.; Holynski, R. (Institute of Nuclear Physics, Krakow (Poland)). *Z. Phys. C;* **1**: No 2, 139-142(1979).

An experimental search is presented for the existence of intranuclear cascading which, for small values of the Bjorken scaling variable ω, is the only mechanism of particle multiplication in the target nucleus. Our data indicate that cascading does exist as one of the effective mechanisms of particle multiplication in μ-nucleus collisions. No significant variation of the observed multiplicity with ω is observed.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 6291, 6302

6296 (ANL-HEP-PR—79-17) **Comparison of jet size in ν^-p interactions with that in e^+e^- annihilation.** Derrick, M.; Fridman, A.; Gregory, P. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

Using new ν^-p charged-current data from the Fermilab 15-foot hydrogen bubble chamber, some properties of the ν^--induced hadronic jets are studied. The angular size of the jets is measured and compared with results from e^+e^- annihilation. The jets in the two processes are found to be quite similar in terms of the variables sphericity, thrust, and energy flow. 15 references.

6297 (ANL-HEP-PR—79-25) **Survey of structures revealed in nucleon-nucleon scattering experiments and dibaryon resonances.** Hidaka, K.; Yokosawa, A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 44p. Dep. NTIS, PC A03/MF A01.

Structures appearing in various experimental data (particularly those with polarized beams) in nucleon-nucleon systems are reviewed. Evidence is presented for the existence of dibaryon resonances with an emphasis on a diproton resonance in $^3F_3$ (J/sup P/ = 3^-) state. 38 references.

6298 (COO—2146-13) **Program in medium energy nuclear physics research. Technical progress report, 1 December 1978-30 November 1979.** Willard, H.B.; Bevington, P.R.; Winkelmann, E.; Leskovec, R.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics). 31 Oct 1979. Contract EY-76-S-02-2146. 8p. Dep. NTIS, PC A02/MF A01.

Experimental results are rported on: the polarization analyzing power proton-deuteron elastic scattering at 796 MeV, and for the pp → dπ^+ reaction at 643 and 796 MeV; the spin-correlation parameter for proton-proton scattering at 643 and 796 MeV; pion production in proton-proton collisions at 800 MeV. A list of publications in included.

6299 (COO—3130TB-253) **Research program in experimental high energy physics. Progress report, January 1, 1979-December 31, 1979.** Shapiro, A.M. (Brown Univ., Providence, RI (USA)). 1 Oct 1979. Contract EY-76-C-02-3130. 70p. Dep. NTIS, PC A04/MF A01.

An experimental program in strong and electromagnetic interaction physics of elementary particles is being carried out using three hybrid bubble chamber systems. Experiments are being performed utilizing the accelerators of the laboratories at Batavia, Stanford, and Geneva, Switzerland. The bubble chamber - hybrid system group is engaged in several experiments at the Fermilab. Extensive analysis of multiparticle production in π^-p interactions at 147 GeV/c was carried out, with particular emphasis this year on a comparison of data with electroproduction data of hadrons with high-P/sub T/ and with the Field and Feynman quark-quark scattering model. Preliminary results have also been presented on an investigation of π^+p, K^+p, and pp interactions at the same momentum; and this work is continuing. Two much higher statistics experiments will start later in 1980 at FNAL to study π^{+-}, K^+, and p^{+-} interactions in hydrogen, and in aluminum, silver, and gold foils, at beam momenta of 200 and 400 GeV/c. A similar study of π^+p, K^+p, and pp interactions at 250 to 300 GeV/c using the large European Hybrid System at CERN will also be started. In addition, we shall begin an experiment on charm and vector meson photoproduction in a polarized monoenergetic backscattered laser beam of 20 GeV using the SLAC Hybrid Facility. A list of publications is included.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 6291, 6296, 6299

6300 (ANL-HEP-CP—79-20) **Structures revealed in p-p and p-n scattering experiments and dibaryon resonances.** Yokosawa, A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 27p. Dep. NTIS, PC A03/MF A01.

A striking energy dependence has been observed in the difference between the p-p total cross sections for parallel and antiparallel longitudinal spin states, $\Delta\sigma$/sub L/ = σ/sup Tot/(reversible) - σ/sup Tot/(reversible). The structure lab/appears around p/sub lab/ = 1.5 GeV/c where $\Delta\sigma$/sub L/ = -16.7 mb and is seen in σ/sup Tot/(reversible) rather than σ/sup Tot/(reversible). The experiments were performed at Argonne National Laboratory using a standard transmission technique. From the dispersion analysis of a forward p-p scattering amplitude using the data on $\Delta\sigma$/sub L/, Grein and Kroll have shown that the Argand plot of the amplitude has a clear resonance-like behavior around proton-incident momentum of 1.5 GeV/c. At the same energy range, the p-p polarization at fixed -t also shows a remarkable energy dependence. In addition, a prominent energy dependence was observed for C/sub LL/ = (L,L;0,0), the spin correlation parameter for elastic pp scattering with beam and target both longitudinally polarized. The possibility of a resonance was further pursued by studying Legendre expansion coefficients of p-p differential cross section and polarization data. The analysis showed a partial wave, $^3F_3$ consistent with having a resonant behavior. Based on a phase-shift analysis, Hoshizaki also showed that $^3F_3$ seems to resonant. This resonant state would have the quantum number J/sup P/ = 3^-, mass ~ 2260 MeV, width ~ 200 MeV and elasticity 20 to 30%. This exotic state may be described by the MIT bag model. Also speculated are several more diproton (I = 1) and dinucleon (I = 0) resonances in the mass region 2100 to 2800 MeV. 35 references.

6301 (COO—1545-266) **Comparison of the differential cross-sections for π^-p → eta 'n and π^-p → eta n at 8.45 GeV/c.** Stanton, N.R.; Edwards, K.W.; Legacey, D. (Ohio State Univ., Columbus (USA). Dept. of Physics; Carleton Univ., Ottawa, Ontario (Canada). Dept. of Physics; McGill Univ., Montreal, Quebec (Canada). Dept. of Physics; Toronto Univ., Ontario (Canada). Dept. of Physics). 1979. Contract EY-76-C-02-1545. 20p. Dep. NTIS, PC A02/MF A01.

The ratio R of the differential cross sections for π^-p eta'n and π^-p eta n was measured with high statistics and small systematic errors at 8.45 GeV/c. R is generally interpreted as the relative content of nonstrange, ground-state quarks in eta' and eta. It is found that R decreases with increasing t; however, extrapolation to t = 0 gives R(0) = 0.672 +- 0.032 (statistical) +- 0.047 (systematic) for the dominant spin flip cross sections, and R(0) = 0.500 +- 0.085 +- 0.035 for the spin nonflip, in excellent agreement with results at higher energy.

6302 (LBL—8969) **K^-p backward elastic scattering between 476 and 1084 MeV/c.** Hamilton, R.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 124p. Dep. NTIS, PC A06/MF A01.

Thesis.

The differential cross-section for K^-p backward elastic scattering was measured in steps of 10-20 MeV/c between 476 and 1084 MeV/c at the Brookhaven AGS. A negative kaon beam was focused onto a 21 cm long liquid hydrogen target and the forward scattered protons were identified kinematically by means of a single arm magnetic spectrometer. A Monte Carlo computer program aided in the subtraction of background events and in the calculation of correction factors. The new data have an average statistical precision of 2.5% which is an order of magnitude improvement over previous results. Together with a new partial wave analysis, the new data give additional evidence for a resonance between 1700 and 1725 MeV. The best fit to the data finds this to be a D_{13} resonance with a mass of 1708 MeV and a width of 27 MeV. Comparable improvement in precision was also obtained in a measurement of the differential cross section for $K^-p \rightarrow \Sigma^-\pi^+$ in which the π^+ emerges at 0^0. 47 references.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

6303 (SAN—0034-191-T1) **High energy particle physics research. Annual progress report.** (California Univ., Davis (USA)). 1979. Contract EY-76-S-03-0034-191. 16p. Dep. NTIS, PC A02/MF A01.

Theoretical high-energy physics research at UC Davis for the year ending January 31, 1980, is briefly recounted in abstract-length summaries. Additional activities are sketched. Completed work will be/has been published in appropriate journals. (RWR)

GENERAL

6304 (COO—3130TA-347) **Research program in theoretical high-energy physics. Progress report.** Feldman, D.; Fried, H.M.; Guralnik, G.S. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Oct 1979. Contract EY-76-C-02-3130. 19p. Dep. NTIS, PC A02/MF A01.

Last year's research program dealt with a large range of topics in high energy theoretical physics. Included in the problems studied were: flavor mixing angles in flavor gauge theory; grand unification schemes; neutral current phenomenology; charmonium decays; perturbative aspects of soft hadronic phenomena within the framework of the dual topological expansion; Regge trajectory slopes and the shape of the inclusive spectra; bound states in quantum electrodynamics; calculations of the Lamb Shift and hyperfine splitting in hydrogen (and muonium) through order $\alpha(Z\alpha)^6$; perturbation theory resummation techniques; collective behavior of instantons in quantum chromodynamics; 1/N expansion and mean field expansion techniques (applied to the nonlinear σ model, classical solutions to Yang-Mills theories, and renormalized four-Fermi models of weak interactions); semiclassical calculation of $Z_1(\alpha)$ in

scalar QED; group theoretic studies of spontaneous symmetry breaking; fibre bundles applied to the topological aspects of gauge theories; strong-coupling expansions (as an aspect of infrared behavior, as a systematic perturbation expansion with reference to lattice extrapolation, applied to classical statistical mechanics, applied to problems with nonquadratic kinetic energy terms, and in transfer matrix formulations); eikonal methods (three-body Coulomb scattering, quark-antiquark potentials); computer augmented solutions to quantum field theory; topological excitations in two-dimensional models and WKB approximation on a lattice. A list of publications is included.

FIELD THEORY

6305 (COO—1545-263) **Dense and dilute instanton-anti-instanton pair configurations.** Palmer, W.F.; Pinsky, S.S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1979. Contract EY-76-C-02-1545. 10p. Dep. NTIS, PC A02/MF A01.

We present a Yang-Mills gauge field configuration which for large values of a separation parameter is an instanton-anti-instanton pair. At a minimum finite separation the field is a pure gauge. The interaction is calculated for large and small separations. According to an approximation algorithm the configuration is the most important quantum fluctuation about the exact solutions. 3 references.

PHYSICS RESEARCH (CONT.)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

6306 (HEDL-SA—1906-FP) **Coupled channels model for radiative capture of nucleons by ^{12}C.** Johnson, D.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 6p. (CONF-791058—44). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A simple model based upon coupled-channels scattering calculations for nucleons on ^{12}C was applied to the corresponding radiative capture reactions. It includes only electric dipole transitions via direct capture plus capture occurring via intermediate states consisting of only the 2^+ first excited state of ^{12}C coupled to a nucleon in the (s,d) shell. It is shown that the shape and magnitude of measured excitation functions of the $^{12}C(p,\gamma_0)$ and $^{13}C(\gamma,n_0)$ reactions are largely reproduced for excitation energies up to about 10 MeV. Furthermore, it is shown that the excitation functions are strongly affected by competition and interference between direct capture and the indirect modes. Angular distribution data are also fairly well reproduced by the model. Implications of the success of the model are discussed. 9 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

6307 (LA-UR—79-2827) **Search for light neutron-deficient nuclei produced in 800 MeV proton spallation reactions.** Vieira, D.J.; Butler, G.W.; Perry, D.G.; Poskanzer, A.M.; Remsberg, L.P.; Natowitz, J.B. (Los Alamos Scientific Lab., NM (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Brookhaven National Lab., Upton, NY (USA); Texas A and M Univ., College Station (USA)). 1979. Contract W-7405-ENG-36. 8p. (CONF-790968—5). Dep. NTIS, PC A02/MF A01.

From 6. international conference on atomic masses; East Lansing, MI, USA (18 Sep 1979).

Time of flight techniques were used to search for new neutron-deficient nuclei at the limits of proton stability using proton spallation of calcium fluoride, nickel, and molybdenum 92 at 800 MeV. Emphasis was placed on neutron-deficient isotopes from magnesium to argon. 18 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6309

6308 **Cluster model approach to the fission of ^{28}Si.** Golin, M.B. (Brookhaven National Lab., Upton, NY (USA)). *Phys. Lett., B;* **81**: No. 1, 5-7(29 Jan 1979).

The electron induced fission of ^{28}Si is described in the alpha cluster model with angular momentum and parity projection. An intermediate state with significant clustering into $^{12}C+^{16}O$ is found to be compatible with the recent experimental data.

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 6312

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6315

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6322

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6326

6309 (CONF-791058—30) **Consistent nuclear model for compound and precompound reactions with conservation of angular momentum.** Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The exciton model is modified such that it automatically reduces to the usual evaporation formula after equilibrium has been reached. The result is further modified to conserve angular momentum in a form compatible with the Hauser-Feshbach formula. This approach allows a consistent description of intermediate excitations from which tertiary reaction cross sections can be calculated for transitions to discrete residual levels with known spins and parities. Level densities used for the compound component of reaction cross sections are derived from direct summation of the particle-hole state densities used for the precompound component.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6307

6310 (HEDL-S/A—1908-FP) **Evaluations of the $^{58}Fe(n,\gamma)^{59}Fe$, and $^{54}Fe(n,p)^{54}Mn$ reactions for the ENDF/B-V dosimetry file.** Schenter, R.E.; Schmittroth, F.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1979. Contract EY-76-C-14-2170. 15p. (CONF-791058—40). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A generalized least-squares adjustment procedure was used to evaluate two important dosimetry reactions for the ENDF/B-V files. Calculations for the cross section adjustments were made with the computer code FERRET, where input data included both integral and differential experimental data results. For the ^{54}Fe reaction, important ratio measurements were renormalized to ENDF/B-V evaluations of $^{235}U(n,f)$, $^{238}U(n,f)$, and $^{56}Fe(n,p)$. A priori curves which are required for the calculations were obtained using Hauser-Feshbach calculations from the codes NCAP (^{58}Fe) and HAUSER-5 (^{54}Fe). Covariance matrices were also calculated and are included in the evaluations. 8 figures, 1 table.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6322

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6309, 6311

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

REFER ALSO TO CITATION(S) 6307

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6322

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6309

6311 (UCRL—82999) **Capture cross section and gamma-ray spectrum calculations for medium-weight nuclei.** Gardner, M.A.; Gardner, D.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791058—46). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A double-peak, energy-dependent Breit-Wigner model of the E1 gamma-ray strength function was applied to nuclei from As to Rh, to predict their neutron capture cross sections and capture gamma-ray spectra. A consistent set of model parameters was obtained in this mass region to describe the step in the low-energy tail of the E1 strength function. This step allows agreement with photonuclear data at high energies, the correct Γ/sub gamma/ to be obtained for agreement with neutron capture cross-section data, and the calculation of the observed hardness in the capture gamma-ray spectra. For nuclei at or near the closed, N = 50 shell, however, the double-peak assumption breaks down. In these cases, good results are still obtained if the same set of model parameters is applied, except that the E1 strength function is formulated in terms of the first, narrower peak. 8 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

6312 (LBL—9876) **Studies of isospin quintets and neutron-deficient indium isotopes with the on-line mass analysis system RAMA.** Cerny, J.; Aysto, J.; Cable, M.D.; Haustein, P.E.; Moltz, D.M.; von Dincklage, R.D.; Parry, R.F.; Wouters, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 13p. (CONF-790968—6). Dep. NTIS, PC A02/MF A01.

From 6. international conference on atomic masses; East Lansing, MI, USA (18 Sep 1979).

The success of the isobaric multiplet mass equation in relating mass excesses of members of light isospin quarters has permitted it to pay a significant role in predicting ground state masses of highly proton-rich 1f2p shell nuclides. An overview is given of an experimental program that was developed to study the most proton-rich members of high-isospin multiplets through radioactive decay. An instrument known as RAMA, for Recoil Atom Mass Analyzer, was constructed and is briefly described. Experiments to determine total decay energies of isotopes in the vicinity of the doubly-magic nucleus ^{100}Sn were begun. Preliminary results on the total decay energies and mass excesses of ^{103}In and ^{105}In are given. 6 figures, 2 tables. (RWR)

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 6312

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6307

6313 (CONF-791058—20) **Neodymium, samarium and europium capture cross-section adjustments based on EBR-II integral measurements.** Anderl, R.A.; Harker, Y.D.; Schmittroth, F. (Idaho National Engineering Lab., Idaho Falls (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-07-1570. 7p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Integral capture measurements were made for highly enriched isotopes of neodymium, samarium and europium irradiated in a row 8 position of EBR-II with samples located both at mid-plane and in the axial reflector. Broad response, resonance, and threshold dosimeters were included to characterize the neutron spectra at the sample locations. The saturation reaction rates for the rare-earth samples were determined by post-irradiation mass-spectrometric analyses and for the dosimeter materials by the gamma-spectrometric method. The HEDL maximum-likelihood analysis code, FERRET, was used to make a least-squares adjustment of the ENDF/B-IV rare-earth cross sections based on the measured dosimeter and fission-product reaction rates. Preliminary results to date indicate a need for a significant upward adjustment of the capture cross sections for ^{143}Nd, ^{145}Nd, ^{147}Sm and ^{148}Sm. 14 references.

6314 (HEDL-SA—1907) **Evaluations of fission product capture cross sections for ENDF/B-V.** Schenter, R.E.; Johnson, D.L.; Mann, F.M.; Schmittroth, F. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 6p. (CONF-791058—42). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Capture cross section evaluations were made for the 36 most important fission product absorbers in a fast reactor system. These evaluations were obtained by use of a generalized least-squares approach with calculations being performed with the computer code FERRET. These results will provide the major revisions to the ENDF/B-IV Fission Product Cross Section File which will be released as part of ENDF/B-V. Input for the cross section adjustment calculations included both integral and differential experimental data results. The differential cross sections and their uncertainties were obtained from the CSIRS library. Integral measurement results came from CFRMF and STEK Assemblies 500, 1000, 2000, 3000, and 4000. Comparisons of these evaluations with recent capture measurements are presented. 14 figures.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6322

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6325, 6326

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6313, 6329

6315 (DOE/S/2696—8) **Determination of neutron cross sections and resonance parameters for the stable tellurium isotopes for thallium 205, for the osmium isotopes, and for uranium 238. Progress report, March 1, 1979-November 1, 1979.** Winters, R.R. (Denison Univ., Granville, OH (USA)). 29 Oct 1979. Contract EY-76-S-02-2696. 21p. Dep. NTIS, PC A02/MF A01.

Measurements of neutron capture and total cross sections for ^{186}Os, ^{187}Os, and ^{189}Os, neutron inelastic scattering cross sections for ^{187}Os and ^{238}U, and total cross sections for ^{32}S + n are reported. This report is administrative in nature, with few data. 7 figures. (RWR)

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 6322

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

SPONTANEOUS AND INDUCED FISSION

6316 (CONF-791058—36) **Calculated particle production spectra and multiplicities from nucleon-fissile element collisions at medium energies.** Alsmiller, F.S.; Alsmiller, R.G. Jr.; Gabriel, T.A.; Lillie, R.A.; Barish, J. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A fission channel was added to the intranuclear-cascade-evaporation model of nuclear reactions so that this model could be used to obtain the differential particle production data that are needed to study the transport of medium-energy nucleons and pions through matter. The earlier work of Hahn and Bertini on the incorporation of fission-evaporation competition into the intranuclear-cascade-evaporation model was retained, and the statistical model of fission was utilized to predict particle production from the fission process. Approximate empirically derived kinetic energies and deformation energies are used in the statistical model. The calculated residual nuclei distributions are in reasonable agreement

with experimental data, but the neutron multiplicities at the higher incident nucleon energies ≧ 500 MeV are sensitive to the level density parameter used. 4 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

6317 **Nuclear levels in ^{233}Th excited by neutron capture.** Jeuch, P.; von Egidy, T.; Schreckenbach, K.; Mampe, W.; Boerner, H.G.; Davidson, W.F.; Pinston, J.A.; Roussille, R. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)); Greenwood, R.C.; Chrien, R.E. (Brookhaven National Lab., Upton, NY (USA)). *Nucl. Phys., A;* 317: No. 2-3, 363-387(9 Apr 1979).

The excited levels in ^{232}Th have been studied using thermal and average resonance neutron capture in ^{232}Th. 2 keV and 24 keV neutron capture has been investigated at the Brookhaven HFBR filtered beam facility. Conversion electrons and low energy γ-rays following thermal neutron capture have been measured at the ILL, Grenoble. From the combination of these data a level scheme of ^{233}Th proposed, which includes all low-spin states up to about 900 keV. Nine Nilsson configurations have been identified. Several rotational bands are explained as β, γ and octupole vibrational excitations. β-vibrational bands coupled to the [631] Nilsson states could be identified from the observation of transitions having strong EO admixtures.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 6315, 6317

6318 (CONF-791058—19) **Measurement of the integral capture and fission cross sections for ^{232}Th in the CFRMF.** Anderl, R.A.; Harker, Y.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The recent evaluation of the cross-section data bases for ^{232}Th capture and fission emphasized significant normalization discrepancies between the available differential data. To help resolve the normalization discrepancies, the capture and fission integral cross sections were measured for ^{232}Th in the fast neutron zone of the Coupled Fast Reactivity Measurements Facility (CFRMF). The cross sections are derived from the radiometric determination of the saturation reaction rates for fission and capture based on the Ge(Li) spectrometric measurement of the absolute gamma emission rates of the 537-keV and 1596-keV lines in the ^{140}Ba - ^{140}La decay and the 311.9-keV line in the ^{233}Pa decay. For capture and fission, respectively, the measured integral cross sections are 291 mb +- 3% and 19.6 mb +- 5%. The ratios of the integral cross sections computed with ENDF/B-IV thorium cross sections and the CFRMF neutron spectrum to the above values are 0.99 for capture and 0.90 for fission. 19 references.

6319 (CONF-791058—21) **Integral measurements for higher actinides in CFRMF.** Harker, Y.D.; Anderl, R.A.; Turk, E.H.; Schroeder, N.C. (EG and G Idaho, Inc., Idaho Falls (USA); Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 4p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

To improve upon the lack of fast integral data for higher actinides, an effort is underway to measure integral capture and fission cross sections for ^{243}Pu, ^{241}Am and ^{243}Am in the fast neutron zone of the Couple Fast Reactivity Measurements Facility (CFRMF). Fission cross sections are determined based on the Ge(Li) gamma spectrometric measurements of the absolute emission rates of the 537-keV and/or 1596-keV lines in the ^{140}Ba - ^{140}La decay. The capture rate for ^{242}Pu is based on the measurement of the absolute emission rate of the 84.0 keV line in the ^{243}Pu β^- decay. Although the capture cross sections for ^{241}Am and ^{243}Am are not obtained directly, the cross sections for production of ^{242}Cm and ^{244}Cm are based on the quantitative alpha spectrometry and total alpha counting. Measured integral and capture cross sections for ^{243}Pu are 357 mb +- 10% and 146 mb +- 15%. Corresponding spectral averaged cross sections calculated using ENDF/B-IV data and 489 mb and 238 mb, respectively. For ^{241}Am fission and capture the measured cross sections are 504 mb +- 12% and 1.01 b +- 3%, respectively. For ^{243}Am fission and capture, the measure cross sections are 0.352 b and .10 b, respectively. 19 references.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 6318, 6319

6320 (LA-UR—79-2703) **Status of ENDF/B-V fission yields.** England, T.R.; Schenter, R.E.; Rider, B.F.; Liaw, J.L. (Los Alamos Scientific Lab., NM (USA); Hanford Engineering Development Lab., Richland, WA (USA); General Electric Co., Pleasanton, CA (USA). Vallecitos Nuclear Center; Oklahoma Univ., Norman (USA)). 1979. Contract W-7405-ENG-36. 11p. (CONF-791051—6). Dep. NTIS, PC A02/MF A01.

From 3. ASTM-EURATOM symposium on reactor dosimetry; Ispra, Italy (1 Oct 1979).

The features of ENDF/B-V with respect to fission yields are described. Yields for approximately 1100 nuclides are given for each of 11 fissioning nuclides at one or more fission-neutron energies, plus the yield uncertainties. Selected chain yields and uncertainties are illustrated. Aspects of the evaluation process are discussed. 4 figures, 3 tables. (RWR)

6321 (LA-UR—79-2899) **High-resolution fission cross section of ^{231}Pa.** Plattard, S.; Auchampaugh, G.F.; Hill, N.W.; de Saussure, G.; Perez, R.B.; Harvey, J.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 17p. (CONF-791058—18). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

A high resolution fission cross section for ^{231}Pa was measured at ORELA from 0.1 to 12 MeV and between 0.4 eV and 10 keV. The data show evidence for (1) fractionated vibrational structures in the threshold region of the fission cross section, and (2) narrow fisson resonances above 1.3 eV with an average fission width < Γ/ sub f/ > = 8 μeV. 16 references.

NUCLEAR THEORY

NUCLEAR STRUCTURE

6322 (BNL—26770) **Pseudomagic nuclei.** Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 7p. (CONF-790976—6). Dep. NTIS, PC A02/MF A01.

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

It was shown previously that, below a critical angular momentum, yrast bands of nonmagic nuclei are well described by the two-parameter variable moment of inertia model. Some striking exceptions to this rule are found in nuclei which have the same mass number as doubly magic nuclei but possess either one (or two) proton pairs beyond a magic number and one (or two) neutron hole pairs, or vice versa. Yrast bands in these pseudomagic nuclei resemble those in magic nuclei. 17 references.

NUCLEAR REACTIONS AND SCATTERING

6323 (CONF-791096—1) **TDHF for heavy ions.** Maruhn, J.A. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy; Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From International symposium on deep inelastic reactions and fusion with heavy ions; Berlin, F.R. Germany (23 Oct 1979).

The main consequences of the TDHF approximation are discussed and the present status of comparison with experimental data. It is intended that this will help to answer the question of whether the results obtained from the method are in reasonable proportion to the effort invested. 27 references. (JFP)

6324 (HEDL-TME—78-83) **Hauser*5, a computer code to calculate nuclear cross sections.** Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Jul 1979. Contract EY-76-C-14-2170. 80p. Dep. NTIS, PC A05/MF A01.

HAUSER*5 is a computer code that uses the statistical (Hauser-Feshbach) model, the pre-equilibrium model, and a statistical model of direct reactions to predict nuclear cross sections. The code is unrestricted as to particle type, includes fission and capture, makes width-fluctuation corrections, and performs three-body calculations - all in minimum computer time. Transmission coefficients can be generated internally or supplied externally. This report describes equations used, necessary input, and resulting output. 2 figures, 4 tables.

6325 (LBL—9520) **Nuclear collision at E/A ≃ T/sub F/.** Randrup, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 23p. (CONF-790743—8). Dep. NTIS, PC A02/MF A01.

From Symposium on heavy ion physics from 10-200 MeV/A; Upton, NY, USA (16 Jul 1979).

A qualitative discussion of nuclear collisions in which the bombarding energy per nucleon is up to the order of the Fermi kinetic energy is made. The significant processes encountered as bombarding energy increases from a few MeV to energies large in

comparison with rest energies are sketched. An estimate of the nucleon mean free path is obtained, and nuclear dynamics at moderate excitation is discussed. At the higher bombarding energies, prompt emission of one or several particles may take place: Fermi jets, two-body collisions, and the possibility of hot spots are discussed. The calculated distribution of promptly emitted neutrons from the collision of 152-MeV ^{12}C with ^{158}Gd is shown. When the beam energy per nucleon is of the same order as the Fermi kinetic energy, the energy available for intrinsic excitation is comparable to the total nuclear binding energy. It is energetically possible to dissemble the colliding nuclei into their nucleon constituents. In such a situation there exists competition among a large number of widely different fragmentations. 4 figures. (RWR)

NUCLEAR MODELS

6326 Long range absorption and other direct reaction components in the optical potential. Baltz, A.J. (Brookhaven National Lab., Upton, NY (USA)); Glendenning, N.K.; Kauffmann, S.K.; Pruess, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 384-397 of Microscopic optical potentials. Proceedings. von Geramb, H.V. (ed.). Berlin, Germany, F.R.; Springer (1978).

From Workshop on microscopic optical potentials; Hamburg, F.R. Germany (25 Sep 1978).

The effect of a strongly coupled inelastic excitation upon elastic scattering is represented as an optical potential component. In particular, a long range imaginary optical potential approximating the effects of quadrupole Coulomb excitation has been derived in closed form. An analytical closed form for sub-Coulomb elastic scattering is obtained by inserting this potential into a weak-absorption model, and connection is made with the semi-classical theory of Coulomb excitation. Above the Coulomb barrier, the long range absorptive potential may be incorporated into an optical model code. Alternatively a more elaborate analytical formulation has been made of the cross section itself in the weak-absorption model. The potential component arising from nuclear excitation of an inelastic state may be evaluated numerically on a computer. Two examples computed (50 MeV α scattering on ^{154}Sm and 60 MeV ^{16}O scattering on ^{40}Ca) exhibit strong l-dependence in the potential component.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 6282

6327 (CONF-790909—13) **Neutron inelastic scattering experiments on the mixed-valent compound YbCuAl.** Mattens, W.C.M.; de Boer, F.R.; Murani, A.P.; Lander, G.H. (Amsterdam Univ. (Netherlands). Natuurkundig Lab.; Institut Max von Laue - Paul Langevin, 38 - Grenoble (France); Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From International conference on magnetism; Munich, F.R. Germany (Sep 1979).

The dynamical susceptibility of YbCuAl has been established by means of time of flight neutron scattering experiments. Non-Korringa behavior of the quasi-elastic line-width has been found and comparison with NMR data will be given.

6328 (LA—8089-M) **THREETRAN (hex, z) users' manual.** Walters, W.F.; O'Dell, R.D.; Brinkley, F.W. Jr. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 60p. Dep. NTIS, PC A04/MF A01.

THREETRAN (hex,z) is a three-dimensional, multigroup, discrete-ordinates neutral-particle transport code for use in solving problems in hexagonal, z geometries. An efficient and flexible data management strategy is incorporated and uses three hierarchies of storage: fast core (or small core memory), extended core (or large core memory), and random access disk. Both isotropic (P_0) and linearly anisotropic (P_1) scattering can be treated. This manual is intended to be a guide for the users of THREETRAN (hex,z) in setting up problem input and in interpreting the output. It is not intended to provide a description of code theory or architecture. 5 figures, 4 tables.

6329 (LA-UR—79-3201) **Neutron spectrum at 90° from 800 MeV (p,n) reactions on a Ta target.** Howe, S.D.; Lisowski, P.W.; King, N.S.P.; Russell, G.J.; Donnert, H.J. (Los Alamos Scientific Lab., NM (USA); Kansas State Univ., Manhattan (USA)). 1979. Contract W-7405-ENG-36. 4p. (CONF-791058—45). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The neutron time-of-flight spectrum produced by a thick tantalum target bombarded by 800-MeV protons was measured at an angle of 90°. The data were taken at the Weapons Neutron Research facility by use of a cylindrical Ta target with a radius of 1.27 cm and a length of 15 cm. An NE-213 liquid scintillator was used to detect the neutrons over an energy range of 0.5 to 350 MeV. The neutron yield is presented and compared to a intranuclear-cascade/evaporation model prediction. 3 figures.

6330 Introduction to particle penetration. Energy loss and scattering of ions in matter. Sigmund, P. (Odense Univ., Denmark). pp 285-288 of Physics of ionized gases. Janev, R.K. (ed.). Beograd, Yugoslavia; Inst. of Physics (1978).

From 9. symposium on the physics of ionized gases; Dubrovnik, Yugoslavia (28 Aug 1978).

Particle penetration phenomena are discussed in terms of the classical example of the stopping and scattering of alpha particles in gases. After a specification of thick and thin targets in the context of particle penetration, the discussion concentrates on thin targets from both a statistical and a collisional view point. 24 references. (JFP)

NEUTRON INTERACTIONS WITH MATTER

6331 (CONF-791058—34) **VITAMIN E: a multipurpose ENDF/B-V coupled neutron-gamma cross section library.** Barhen, J.; Cacuci, D.G.; Ford, W.E. III; Roussin, R.W.; Wagschal, J.J.; Weisbin, C.R.; White, J.E.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The US Department of Energy Office of Fusion Energy and the Division of Reactor Research and Technology jointly sponsored the development of a coupled fine-group cross section library (VITAMIN-C). The experience gained in the generation, validation, and utilization of the VITAMIN-C library along with its broad range of applicability has led to the request for updating this data set using ENDF/B-V. Additional support in this regard has been provided by the Defense Nuclear Agency (DNA) and by EPRI in support of weapons analyses and light water reactor shielding and dosimetry problems, respectively. The rationale for developing the multipurpose ENDF/B-V-based VITAMIN-E library is presented, with special emphasis on new models used in the data generation algorithms. The library specifications and testing procedures are also discussed in detail. The distribution of the VITAMIN-E library is currently subject to the same restrictions as the distribution of the ENDF/B-V data. 2 tables.

6332 (HEDL-SA—1867-FP) **Computational benchmark for deep penetration in iron.** Carter, L.L.; Hendricks, J.S. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1979. Contract EY-76-C-14-2170. 19p. (CONF-791103—49). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A benchmark for calculation of neutron transport through iron is now available based upon a rigorous Monte Carlo treatment of ENDF/B-IV and ENDF/B-V cross sections. The currents, flux, and dose (from monoenergetic 2, 14, and 40 MeV sources) have been tabulated at various distances through the slab using a standard energy group structure. This tabulation is available in a Los Alamos Scientific Laboratory report. The benchmark is simple to model and should be useful for verifying the adequacy of one-dimensional transport codes and multigroup libraries for iron. This benchmark also provides useful insights regarding neutron penetration through iron and displays differences in fluxes calculated with ENDF/B-IV and ENDF/B-V data bases. (GHT)

6333 (ORO—2504-309) **Measurement of ultracold neutrons produced by using Doppler-shifted Bragg reflection at a pulsed-neutron source.** Brun, T.O.; Carpenter, J.M.; Krohn, V.E.; Ringo, G.R.; Cronin, J.W.; Dombeck, T.W.; Lynn, J.W.; Werner, S.A. (Argonne National Lab., IL (USA); Chicago Univ., IL (USA); Maryland Univ., College Park (USA); Missouri Univ., Columbia (USA)). 1979. Contract EY-76-C-05-2504. 6p. Dep. NTIS, PC A02/MF A01.

Ultracold neutrons (UCN) have been produced at the Argonne pulsed-neutron source by the Doppler shift of 400-m/s neutrons Bragg reflected from a moving crystal. The peak density of UCN produced at the crystal exceeds 0.1 n/cm^3.

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

REFER ALSO TO CITATION(S) 6329

6334 (CONF-790968—9) **Gamma-ray energy calibration standards.** van der Leun, C.; Helmer, R.G.; Van Assche, P.H.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1979. Contract EY-76-C-07-1570. 10p. Dep. NTIS, PC A02/MF A01.

From 6. international conference on atomic masses; East Lansing, MI, USA (18 Sep 1979).

The first official report is presented of the task group on gamma-ray calibration standards, established by the IUPAP Commission on Atomic Masses and Fundamental Constants. The report presents a consistent set of gamma ray energies, all with uncertainties of, at most, 10 ppM. (GHT)

DOSIMETRY

6335 (COO—1105-(261-268)) **Fast neutron dosimetry. Progress report, July 1, 1978-June 30, 1979. Wisconsin Medical Physics report No. WMP-109.** Attix, F.H. (Wisconsin Univ., Madison (USA)). 1979. Contract EY-76-S-02-1105. 249p. Dep. NTIS, PC A11/MF A01.

Research activities relating to neutron dosimetry at the University of Wisconsin conducted between 1961 and 1979 are comprehensively reviewed. Former principal investigators discuss the activities and accomplishments which occurred during their tenure, and the current principal investigator discusses future plans. Seven reprints of papers dealing with specific aspects of the program are included in the report, but have not been indexed separately. (ERB)

6336 (ORO—4814-T1) **Development and application of the electrochemical etching technique. Annual progress report.** (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). Aug 1979. Contract EY-76-S-05-4814. 57p. Dep. NTIS, PC A04/MF A01.

This report documents advances in the development and application of the electrochemical etching technique for thermal and epithermal neutron dosimetry as well as track geometry determinations. The bulk and track etching rates were studied by evaluating the track geometry during electrochemical etching. The foil surface removed versus etching time for two different etchants at 1000 V, 2 kHz, and 22°C were studied. Results indicated that the bulk etching rates were constant for the two etchants, i.e. 45% KOH and 45% KOH mixed with an equal volume of $C_2H_5OH_5$ and were equal to 0.20 +- 0.14 μm/hr and 2.7 +- 0.27 μm/hr from each side of the foil. The track etching rate (as contrasted with the bulk etching rate) can be determined by the microscope focus at various depths. The increase of track depth values as a function of etching time for the two etchants are plotted. The track cone angles were determined and found to be much larger for electrochemically etched polycarbonate foils than for most plastics etched with passive chemical techniques.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 5964

6337 (LA-UR—79-3174) **Roles of crystal fields in magnetic superconducting rare-earth rhodium borides.** Maekawa, S.; Huang, C.Y. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 9p. (CONF-791142—3). Dep. NTIS, PC A02/MF A01.

From International Conference on crystal field and structural effects in f-electron systems; Philadelphia, PA, USA (12 Nov 1979).

Among the structural effects on superconductivity and magnetism in RRh_4B_4, those of the tetragonal crystal field of rare earth ions on both magnetic and superconducting properties are discussed. Special attention is paid to RRh_4B_4, with R = Ho, Er, and Tm, and the pseudoternaries Er/sub 1-x/Ho/sub x/Rh_4B_4 and Er/sub 1-x/Tm/sub x/Rh_4B_4. Crystal field effects are concentrated on and other structural effects on superconductivity and magnetism are neglected. Only the lowest crystalline anisotropy field is considered in order to render the discussion clear. (GHT)

6338 **Josephson effect devices.** Clarke, J. (California Univ., Berkeley (USA). Dept. of Physics). *Phys. Bull. (London);* **30**: No. 5, 206-208(May 1979).

The basic concept of the Josephson effect is explained and two applications, the SQUID and computers, are considered. SQUIDs combined flux quantisation and Josephson tunnelling, come in two versions, DC and RF, and are by far the most highly developed and widely used of the Josephson devices. The principles of the two types of system are considered and applications discussed. The exciting possibilities offered by the high speed and very low dissipation of Josephson effect computers are considered. It is hoped that a prototype computer will be available within a few years.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

6339 **Topological solitons and instantons.** Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). *Comments Nucl. Part. Phys.;* **8**: No. 4, 129-134(1978).

Theoreticians working on model field theories have recently developed new approximation techniques for studying the physical content of these difficult to solve systems. The new methods supplementing established perturbative approaches, have made it possible to perform calculations which had never previously been attempted and have shown that quantum field theory can lead to unexpected, intricate and novel phenomena. The physics of the subject naturally divides into two areas. For one class of phenomena the procedure is to seek solutions of the field equations, viewed as c-number equations describing the space-time evolution of a classical field evolution. When such solutions are of the soliton variety (i.e., stable, localized, finite-energy configurations), theorists have found that in the corresponding quantum system there exists particle states in the Hilbert space which are neither the elementary particles of the model, nor bound states of several of those. Rather they are coherent, collective excitations which can be viewed as bound states of an infinite number of elementary particles. For the second class of phenomena, classical field equations are again solved; but not in real time, rather in imaginary time. When such solutions have finite action they are called pseudoparticles or instantons. It is known that the WKB exponent which is encountered in a semiclassical description of tunneling can be considered as the action for motion ocurring in imaginary time. Correspondingly the pseudoparticles indicate the existance of quantum-mechanical tunneling between configurations which cannot be joined by a classical trajectory. For both classes of phenomena, one is studying optimal paths. Quantum mechanics is regained by expanding the quantum theory in a well ordered fashion around these nontrivial classical configurations. A discussion of examples is included.

ELECTRICITY AND MAGNETISM

REFER ALSO TO CITATION(S) 6101

MATHEMATICAL PHYSICS

REFER ALSO TO CITATION(S) 6339

FUSION ENERGY

6340 (DOE/ER—0034) **Status of tokamak research.** Rawls, J.M. (ed.). (General Atomic Co., San Diego, CA (USA); Department of Energy, Washington, DC (USA)). Oct 1979. 161p. Dep. NTIS, PC A08/MF A01.

An overall review of the tokamak program is given with particular emphasis upon developments over the past five years in the theoretical and experimental elements of the program. A summary of the key operating parameters for the principal tokamaks throughout the world is given. Also discussed are key issues in plasma confinement, plasma heating, and tokamak design. (MOW)

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

6341 **Efficient high-power high-energy neutral beams for the reference mirror reactor.** Fink, J.H.; Barr, W.L.; Hamilton, G.W. (Univ of Calif, Lawrence Livermore Lab). *IEEE Trans. Plasma Sci.;* **PS-7**: No. 1, 21-34(Mar 1979).

The neutral beams for the reference mirror reactor are provided via four separate injectors using negative ions created by charge exchange in a cesium-vapor cell and neutralized by photodetachment. Each of the injectors delivers the equivalent of 1800 A of the desired mixture of 150-keV deuterium and tritium neutrals. Each injector consists of 23 ion sources of a modified Lawrence Berkeley Laboratory/Lawrence Livermore Laboratory type, with an associated cesium-vapor cell that converts 20 percent of the positive-ion output into negative ions D;sup -; and T;sup -;. As much as 95 percent of the negative ions are stripped, producing fast neutrals that pass between the cryopumps and shielding into the reactor. Innovations required to attain an overall efficiency of 81.2 percent include a continuously operating cathode for the source, a negative-ion beam line with cooled grids, a high-voltage accelerator with insulators shielded from the neutron and gamma flux, cryopanels that cycle

between pumping and outgassing modes, and recovery of the waste thermal energy and charged beam energy.

6342 Low frequency rf heating with a helical coupler in a hot electron plasma. Hoffman, D.J.; Shohet, J.L. (Univ of Wis, Madison). *IEEE Trans. Plasma Sci.;* **PS-6**: No. 4, 449-453(Dec 1978).

A magnetic mirror (mirror ratio 2.38:1) containing ECRH generated hydrogen plasma, with a density of $5*10^{10}$ cm^{-3} with cold electron temperature of 11 ev, was used to study propagation of an artifically launched wave varying as e/sup j(Ωt+mθ-kz)/ at approximately the ion cyclotron frequency. The wave was transmitted between two similar internally placed helically wound antennas separated by 11 wavelengths. The coupling between them was enhanced by as much as 50 times in the presence of plasma. The m=1 left-handed component was cut off when Ω>Ω/sub ci/. Electron temperatures could be increased by more than 2 times with the m=1 mode, presumably due to ion heating. Little pump-out was observed.

PLASMA DIAGNOSTICS

6343 (GA-A—15641) **Sample system for time resolved tokamak plasma impurity analysis.** Hager, E.R.; Burrell, K.H.; Ellis, L.V.; Ahlgren, D.H.; Gomay, Y. (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76ET51011. 9p. (CONF-791102—18). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A fast sample system for time resolved measurements of material transport and unipolar arcing in ISX-B, located at Oak Ridge National Laboratory, has been designed, fabricated and tested. The sample system consists of a wheel which is driven through about one revolution during ISX plasma discharge. The wheel is driven via a cable and bellows system from outside the plasma chamber. A feedthrough mechanism supports and advances the fast sample system through an isolation valve to the exposure position. A separate vacuum pumping system is provided to evacuate the sample system before opening the isolation valve into the plasma chamber. Provision is made for a heat flux probe and a particle energy analyzer probe to be carried on the same feedthrough. The system is currently installed on ISX and operating experience and data are being gathered.

PLASMA KINETICS - GENERAL

6344 (UCID—18209) **MFTF TOTAL benchmark.** Choy, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1979. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

A benchmark of the TOTAL data base management system as applied to the Mirror Fusion Test Facility (MFTF) data base was implemented and run in February and March of 1979. The benchmark was run on an Interdata 8/32 and involved the following tasks: (1) data base design, (2) data base generation, (3) data base load, and (4) develop and implement programs to simulate MFTF usage of the data base.

PLASMA KINETICS - EXPERIMENTAL

6345 (PPPL—1616) **Thermal desorption measurements of hydrogen-isotope retention in Alcator-A.** Razdow, A.M.; Marmar, E.S.; Cohen, S.A.; Dylla, H.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1979. Contract EY-76-C-02-3073. 19p. Dep. NTIS, PC A02/MF A01.

Results are presented for deuterium retention measurements in type 304 stainless steel exposed in the edge plasma of the Alcator-A tokamak. Stainless steel samples, at 300K, with surface conditions characterized by Auger electron spectroscopy, were introduced into the limiter shadow region for exposure to deuterium plasmas, and then withdrawn into an appended UHV chamber for thermal desorption measurements. For unoxidized samples exposed at the vacuum vessel wall radius, 1 x 10^{15}Dcm^{-2} was retained after exposure to high density (anti n/sub e/ = 3 x 10^{14}cm^{-3}) discharges. Exposure to consecutive series of N discharges produced retention proportional to N/sup 1/2/.

PLASMA KINETICS - THEORETICAL

6346 (COO—2218-137) **Studies of finite gyro-radius effects in a field reversed mirror configuration.** Miley, G.H.; Gilligan, J.G.; Driemeyer, D.E.; Morse, E.C.; Condit, W.C. (Illinois Univ., Urbana (USA). Fusion Studies Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract EY-76-S-02-2218. 4p. (CONF-790912—11). Dep. NTIS, PC A02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

The field-reversed mirror (FRM) is characterized by a small size such that finite gyro-radius effects must be considered in both stability and transport analyses. Consequently, such effects are important to the interpretation of both ongoing experiments and extrapolation to future reactor concepts. The present work employs an energy principle to study stability of low-frequency (ω << Ω/sub ce/, ω ≅ Ω/sub ci/) acoustic modes. Also a Monte Carlo technique has been developed for study of high energy-ion transport.

6347 (COO—2218-139) **Finite orbit treatment of plasma buildup in small mirrors.** Campbell, M.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1979. Contract EY-76-S-02-2218. 6p. (CONF-791103—47). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

In a small mirror plasma (R/sub p//rho/sub i/ ≦ 40) ion finite gyro-radius (F.G.R.) effects become important, particularly at the surface near the vacuum interface. This is because charge-exchange of incoming cold neutrals (from the injector and recycling off the first wall) occurs primarily in a surface layer only a few centimeters thick, causing plasma erosion. A new 2-1/2-D (1-energy, 1-1/2 spatial) dynamic model now being developed (called FOREMD) extends the F.G.R. treatment to a distribution of energies and also includes local magnetic field effects and more accurately calculated beam deposition. (MOW)

6348 (COO—2218-140) **Fusion-product ash buildup in tokamak with radial electric field.** Downum, W.B.; Choi, C.K.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1979. Contract EY-76-S-02-2218. 6p. (CONF-791103—46). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The buildup of thermalized fusion products (ash) in a tokamak can seriously limit burn times. Prior studies have concentrated on deposition profile effects on alpha particle transport in tokamaks but have not considered the effect on ash of radial electric fields (either created internally, e.g. due to high-energy alpha leakage, or generated externally). The present study focuses on this issue since it appears that electric fields might offer one approach to control of the ash. Approximate field and source profiles are used, based on prior calculations. (MOW)

6349 (ORNL/TM—6920) **Lectures on the practical solution of differential equations.** Dresner, L. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 113p. Dep. NTIS, PC A06/MF A01.

This report comprises lectures on the practical solution of ordinary and partial differential equations given in the In-Hours Continuing Education Program for Scientific and Technical Personnel at Oak Ridge National Laboratory.

6350 (PPPL—1621) **Dielectric response in guiding center plasma.** Krommes, J.A.; Similon, P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1979. Contract EY-76-C-02-3073. 23p. Dep. NTIS, PC A02/MF A01.

The dielectric function for guiding center plasma is derived from the direct-interaction approximation. For the special case of thermal equilibrium, the reslt agrees with, although is more detailed than, an earlier calculation of Taylor. An explicit formula for the collision operator Σ' is given. The calculation illustrates several important features of renormalized turbulence theory: cancellation between the so-called diffusion and polarization parts of Σ', and the role of the renormalization in providing the proper description of adiabatic response.

6351 Hybrid simulations of quasineutral phenomena in magnetized plasma. Byers, J.A.; Cohen, B.I.; Condit, W.C.; Hanson, J.D. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Comput. Phys.;* **27**: No. 3, 363-396(Jun 1978).

Presented is a new class of numerical algorithms for computer simulation of low frequency (omega << omega/sub pe/, omega/sub ce) electromagnetic and electrostatic phenomena in magnetized plasma. Maxwell's equations are solved in the limits of negligible transverse displacement current (Darwin's model) and quasineutrality. The numerical models treat electrons as a massless fluid and ions as particles. The numerical stability of the algorithms is investigated analytically and verified by computer experiments. The numerical algorithms, in both linearized and fully nonlinear forms, are successfully applied to the study of linear microinstabilities and the efficiency of injected small amplitude currents in causing the local reduction of the external magnetic field in magnetically confined plasmas.

PLASMA PRODUCTION

6352 Supercritical density modifications of a laser-produced plasma due to resonant cavity fields. Probert, P.; Shohet, J.L.; Hatch, A.J. (Univ of Wis, Madison). *IEEE Trans. Plasma Sci.;* **PS-7**: No. 1, 9-12(Mar 1979).

A laser plasma is produced at the center of a cylindrical cavity while radio-frequency excitation of moderate power is sup-

plied near the TM;sub 011; and TE;sub 111; vacuum-mode frequencies. Probe and particle collector measurements show density modification of the plasma during its decay due to resonances excited by the RF source. The magnitudes of these density changes are found to be near and exceeding critical density.

PLASMA INSTABILITIES

6353 (COO—2218-138) **Reversed-Field Pinch plasma model.** Miley, G.H.; Nebel, R.A.; Moses, R.W. (Illinois Univ., Urbana (USA). Fusion Studies Lab.; Los Alamos Scientific Lab., NM (USA)). 1979. Contract EY-76-S-02-2218. 4p. (CONF-790912—10). Dep. NTIS, PC A02/MF A01.

From 9. European conference on controlled fusion and plasma physics; Oxford, UK (17 Sep 1979).

The stability of a Reversed-Field Pinch (RFP) is strongly dependent on the plasma profile and the confining sheared magnetic field. Magnetic diffusion and thermal transport produce changing conditions of stability. Despite the limited understanding of RFP transport, modelling is important to predict general trends and to study possible field programming options. To study the ZT-40 experiment and to predict the performance of future RFP reactors, a one-dimensional transport code has been developed. This code includes a linear, ideal MHD stability check based on an energy principle. The transport section integrates plasma profiles forward in time while the stability section periodically checks the stability of the evolving plasma profile.

6354 (DOE/TIC—11016) **Velocity space instabilities of alpha particles in tokamak reactors.** Sigmar, D.J. (Oak Ridge Y-12 Plant, TN (USA)). 1979. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

In this lecture on high frequency instability due to isotropic hollow alpha velocity distributions it was first shown that such distributions can actually arise under thermonuclear conditions in a tokamak reactor, particularly for the case of imperfect alpha particle confinement. The toroidal geometry (i.e., the poloidal variation of the alpha gyrofrequency) then leads to linear instability of the compressional Alfven wave $\omega = C/\text{sub } A/k/\text{sub perpendicular/}$ with $k/\text{sub parallel/}$ congruent to O, $k/\text{sub perpendicular/ rho/sub } \alpha/ \geqq 1$, $v/\text{sub } \alpha/ > C/\text{sub } A/$, at the low harmonics ω congruent to $n\ \omega/\text{sub c}\alpha/$. Thus the free energy of the inverted alpha distribution is accessible and produces anomalously rapid diffusion of $F/\text{sub } \alpha/(v/\text{sub perpendicular/})$. (MOW)

6355 **Nonlinear stabilization of m = 2 MHD kink modes.** Pao, Y.P.; Rosenau, P. Contract EY-76-C-02-3077. *Commun. Pure Appl. Math.;* **31**: 647-658(1978).

The present work is concerned with the nonlinear stabilization of the well-known linearly unstable m = 2 magnetohydrodynamic kink modes in a cylindrical plasma with a vacuum interface. We shall study this problem from a perturbational viewpoint and obtain the nonlinear equation which governs the evolution of the mode amplitude. We adopt the method used by Stuart in deriving the Landau equation in fluid mechanics.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 6342

6356 **Fast-wave resonances near the ion cyclotron frequency.** Dollinger, R.E.; Kristiansen, M.; Hagler, M.O. (Tex Tech Univ, Lubbock). *IEEE Trans. Plasma Sci.;* **PS-7**: No. 1, 2-5(Mar 1979).

Wave damping has been observed for the fast (compressional) wave at frequencies that are about 10 percent above the second and third harmonics of the ion cyclotron frequency. Preliminary calculations indicate that this shift is the result of collisions. The waves were launched by a 1-turn loop around the cylindrical plasma column and damped in a magnetic beach. The highly ionized hydrogen or deuterium plasma had an average temperature of 2 eV and an average density of about 2.5*10;sup 20; m;sup -3;.

6357 **Langmuir wave phase velocity in unneutralized beams.** Godfrey, B.B. (Univ of Calif, Los Alamos Sci Lab, NM). *IEEE Trans. Plasma Sci.;* **PS-6**: No. 4, 380-383(Dec 1978).

The dispersion relation is investigated for long wavelength slow Langmuir waves in relativistic particle beam propagating along a strong magnetic guide field in an evacuated metallic waveguide. For a large class of beam radial profiles, wave phase velocity drops to zero with infinite slope as beam current approaches the space-charge limit. This result is of importance to certain collective ion acceleration proposals.

FUSION POWER PLANT TECHNOLOGY

6358 **Nuclear fusion reactor.** Fleet, J.H. (to Dubble Whammy, Inc.). US Patent 4,172,008. 23 Oct 1979. Filed date 23 Aug 1977. 10p.

A rapidly pulsed nuclear fusion reaction system including a firing chamber into which synchronized opposing beams of ionized gas such as deuterium/tritium are injected in the form of ion pulses which are adapted to collide at the mid point of the chamber. The pulsed ion beams are fed through respective orifices across which is applied a relatively high dc voltage. External to the firing chamber is means for generating a pulsed magnetic field interiorally of the chamber along the ion travel path and in synchronism therewith to provide a guiding effect of the two opposing ion beams to the precise center of the firing chamber. A fuel gas ball is thus formed at the center of the firing chamber which is then ignited to fusion temperature by a pair of lasers or a pair of high energy electron beams. The resulting release of energy is collected as heat at the outer surface of the firing chamber by means of the structure comprising the magnetic field generating means which is also adapted to capture neutrons. 24 claims. (MOW)

6359 **Beam heated linear theta-pinch device for producing hot plasma.** Bohachevsky, I.O. (to Dept. of Energy). US Patent Application 960,410. 13 Nov 1978. 8p.

The present invention overcomes the disadvantages and limitations of the prior art by providing a beam heated linear theta-pinch device for producing hot plasmas. According to the present invention, both magnetic and beam energy are utilized to supplement each other to produce a hot plasma. The implosive nature and rapid burn characteristics of the present invention eliminate end loss and plasma instability problems associated with magnetically contained systems. Since the beam energy is not directed at the fuel microcapsule but rather at a surrounding plasma, problems of fuel target damage, beam focusing, pulse shape and duration, and energy absorption properties are alleviated. (MOW)

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 5968, 5988

6360 **Neutral-gas-blanket theory as applied to the Reference Theta-Pinch Reactor. Vols. I and II.** Gryczkowski, G.E. Ann Arbor, MI; Univ. of Michigan (1979). 402p. University Microfilms Order No. 79-25,157.

Thesis (Ph. D.).

The transient formation of a neutral-gas blanket in the quenched Reference Theta-Pinch Reactor and the subsequent quasi-steady penetration of the neutral gas into the plasma core have been investigated. The transient formation of a neutral-gas blanket was investigated to determine under what conditions a neutral-gas layer could be formed and to determine what wall damage would result during the formation process. After the formation of the neutral-gas blanket has been established, a quasi-steady analysis of the neutral gas-plasma interaction was performed to determine if the plasma energy could be extracted in a time consistent with engineering efficiency and with acceptable wall damage. (MOW)

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 6019

6361 (UCRL—82887) **MFTF magnet cryostability.** VanSant, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—26). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A pair of large superconducting magnets will be installed in the Mirror Fusion Test Facility (MFTF), which is to begin operation in 1981. To ensure a stable superconducting state for the niobium-titanium (Nb-Ti) conductor, special consideration has been given to certain aspects of the magnet system design. These include the conductor, joints, coil assembly, vapor plenums, liquid-helium (LHe) supply system, and current leads. Heat transfer is the main consideration; i.e., the helium quality and temperature are limited so that the superconductor will perform satisfactorily in the magnet environment.

6362 **Cryogenic aspects of a demountable toroidal field magnet system for tokamak-type fusion reactors.** Hsieh, S.Y.; Powell, J.; Lehner, J. (Brookhaven National Lab., Upton, NY). *Adv. Cryog. Eng.;* **23**: 185-196(1978).

An alternative TF coil concept which should avoid the difficulties of maintenance and repair is termed the "demountable externally anchored low stress" (IDEALS) magnet system and is intended to provide easier coil installation for reactor construction,

as well as improved accessibility for reactor maintenance and repair. This magnet appears to be the most practical and economical method for tokamak TF magnet systems. It may also be applied to other large superconducting magnet systems. The penalty of the increased refrigeration due to coil supports and high-current leads appears to be quite acceptable.

POWER SUPPLIES, ENERGY STORAGE

6363 (LA—8108-MS) **Early counterpulse technique applied to vacuum interrupters.** Warren, R.W. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 23p. Dep. NTIS, PC A02/MF A01.

Interruption of dc currents using counterpulse techniques is investigated with vacuum interrupters and a novel approach in which the counterpulse is applied before contact separation. Important increases have been achieved in this way in the maximum interruptible current as well as large reductions in contact erosion. The factors establishing these new limits are presented and ways are discussed to make further improvements.

6364 (PPPL—1617) **Harmonic content in the variable-frequency ac power line of TFTR.** Zabar, Z.; Bronner, G.; McMurray, S.; Karady, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1979. Contract EY-76-C-02-3073. 8p. Dep. NTIS, PC A02/MF A01.

Studies were made of the harmonic content of the current and voltage at the generator bus of the Tokamak Fusion Test Reactor. Out of numerous load scenarios, one case was considered in detail. The harmonics were found acceptable for the generator; however, control problems and substantial telecommunications interference may result, requiring appropriate control measures and shielded telecommunication lines.

6365 **Power supply requirements for a tokamak fusion reactor.** Brooks, J.N.; Kustom, R.L. (Argonne National Lab., IL). *Nucl. Technol.;* **46**: No. 1, 61-81(Nov 1979).

The power supply requirements for a 7-m major radius commerical tokamak reactor have been examined, using a system approach combining models of the reactor and poloidal coil set, plasma burn cycle and magnetohydrodynamics calculations, and power supply characteristics and cost data. A conventional system using a motor-generator flywheel set and solid-state rectifier-inverter power supplies was studied in addition to systems using a homopolar generator, superconducting energy storage inductor, and dump resistors. The requirements and cost of the power supplies depend on several factors but most critically on the ohmic heating ramp time used for startup. Long ramp times ($\geqq$ 8 s) seem to be feasible, from the standpoint of resistive volt-second losses, and would appear to make conventional systems quite competitive with nonconventional ones, which require further research and development.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 6341

6366 **Dynamics and control of a packed distillation column for the isotopic enrichment of plasma exhausts from controlled thermonuclear reactors.** Davis, J.F. (Northwestern Univ., Evanston, IL); Mah, R.S.H.; Stevens, W.F.; Misra, B.; Maroni, V.A. *Nucl. Technol.;* **46**: No. 1, 149-158(Nov 1979).

A control scheme is proposed based on our analysis of the disturbances expected during normal operation of the lead column in the fuel enrichment distillation cascade for a near-term tokamak fusion reactor fuel cycle. The primary objective of this control scheme is to minimize both the time and the amount that the atom percent protium in the bottoms product is above a setpoint level. As a secondary objective, distillate stream flow and composition fluctuations should be minimized to avoid downstream operational and control problems without requiring intermediate storage. A fixed material balance control scheme was found to be satisfactory for meeting the control requirements of this system. Because the concentration of protium in the bottoms product (the controlled variable) was relatively small, the distillate stream composition and the tritium/deuterium ratio in the bottoms stream proved to be essentially independent of the choice of controller parameters. This insensitivity permitted the controller parameters to be chosen solely on the basis of the primary objective and led to a high gain setting and low reset value for the controller. With the provision of a bottoms storage to dampen out the effect of oscillatory response, these controller settings minimized the overshoot and produced an averaged protium concentration in the bottoms very close to the setpoint level.

6367 **Neutral-beam injector for the tandem-mirror fusion reactor delivering 147 mw of 1.2-mev d^0.** Fink, J.H.; Hamilton, G.W. (Univ of Calif, Lawrence Livermore Lab). *IEEE Trans. Plasma Sci.;* **PS-6**: No. 4, 417-434(Dec 1978).

A conceptual design of a high-current, 1.2-Mev D^0 injector is presented. This injector has an anticipated operating efficiency of 73%. Major advances in beam technology are needed to meet these specifications, including a continuous source of negativee ions, an efficient electron-stripping cell, and the development of associated power conditioning and control equipment. All components in the proposed beam line are elaborations of physics experiments already reported in the literature; therefore, it should be possible to satisfy the neutral-beam requirements of the tandem-mirror reactor (TMR) in the not too distant future.

6368 **Neutral beam line improvements resulting from a reduction of gas flow.** Forrester, A.T.; Dawson, J.M. (Univ of Calif, Los Angeles). *IEEE Trans. Plasma Sci.;* **PS-6**: No. 4, 574-577(Dec 1978).

A D^+ ion source with a gas utilization efficiency of 85% or greater is feasible and leads to dramatic performance improvements and simplifications of a high energy neutral beam line for fusion reactors. The source should be long compared to present sources and have magnetic multipole boundaries sufficiently intense to be highly reflecting for both ions and electrons. The benefits to be anticipated include the elimination of power dissipation at the acceleration electrodes, removal of the source from direct neutron bombardment, a great reduction in required pumping, and the elimination of reionization losses.

6369 **Revised neutral gas shielding model for pellet-plasma interactions.** Milora, S.L.; Foster, C.A. (Oak Ridge Natl Lab, Tenn). *IEEE Trans. Plasma Sci.;* **PS-6**: No. 4, 578-592(Dec 1978).

A revised neutral molecule ablation model is derived to describe the evaporation of a solid hydrogen pellet in a tokamak plasma. The approach taken is based on the theory of Parks, Turnbull, and Foster who postulate that a cloud of molecular hydrogen surrounding the pellet shields the surface from incoming energetic electrons and, in so doing, regulates the evaporation rate. This treatment differs from the assumption that the flow of material away from the surface is sonic everywhere. Numerical solutions of the fluid dynamic equations, which include the effects of strong electron heating locally in the gas, reveal that the flow of material away from the pellet is initially retarded relative to the solution of Parks et al., and then rapidly accelerated and rarified. This behavior is more pronounced for higher temperature plasmas and the net effect is that pellet life times might be prolonged slightly at the higher temperatuares over those predicted by the approximate sonic flow model. A simple injection depth scaling law is derived and estimates of pellet fueling velocity requirements are made for several tokamaks.

6370 **Compact, maintainable 80-keV neutral beam module.** Fink, J.H.; Molvik, A.W. (to Dept. of Energy). US Patent Application 954,679. 25 Oct 1978. 15p.

A compact, maintainable 80-keV arc chamber, extractor module for a neutral beam system immersed in a vacuum of $< 10^{-2}$ Torr, incorporating a nested 60-keV gradient shield located midway between the high voltage ion source and surrounding grounded frame. The shield reduces breakdown or arcing path length without increasing the voltage gradient, tends to keep electric fields normal to conducting surfaces rather than skewed and reduces the peak electric field around irregularities on the 80-keV electrodes. The arc chamber or ion source is mounted separately from the extractor or ion accelerator to reduce misalignment of the accelerator and to permit separate maintenance to be performed on these systems. The separate mounting of the ion source provides for maintaining same without removing the ion accelerator.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

6371 (CONF-791102—20) **Liquid lithium blanket processing studies.** Talbot, J.B.; Clinton, S.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 22p. Dep. NTIS, PC A03/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The sorption of tritium on yttrium from flowing molten lithium and the subsequent release of tritium from yttrium for regeneration of the metal sorbent were investigated to evaluate the feasibility of such a tritium-recovery process for a fusion reactor blanket of liquid lithium. In initial experiments with the forced convection loop, yttrium samples were contacted with lithium at 300°C. A mass transfer coefficient of 2.5 x 10^{-} cm/sec, which is more than an order of magnitude less than the value measured in earlier static experiments, was determined for the flowing lithium system. Rates of tritium release from yttrium samples were measured to evaluate possible thermal regeneration of the sorbent. Values for diffusion coefficients at 505, 800, and 900°C were estimated to be 1.1 x 10^{-13}, 4.9 x 10^{-12}, and 9.3 x 10^{-10} cm^2/sec, respectively. Tritium release from yttrium was investigated at higher temperatures and with hydrogen added to the argon sweep gas to provide a reducing atmosphere.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 6090

6372 (UCID—18330) **Model of emittance growth in a self-pinched beam.** Lee, E.P.; Yu, S.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1979. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

A semi-phenomenological formula is proposed for the change of emittance of a self-pinched beam which is not matched to its equilibrium radius. Near equilibrium this formula, coupled with an envelope equation, yields the damped sausage oscillations observed in simulation and experiments. For a beam which is injected cold (no transverse velocity spread), the formula coincides with the analytically calculated initial growth of emittance. The basic theory is developed here and used to compute the linear damping rate for several current profiles. The resultant non-linear increase in equilibrium quantities is also calculated in lowest order of the degree of mismatch.

6373 (UCRL—13944) **Conceptual design study of the hylife lithium waterfall laser fusion chamber. FY 1978 annual report to Lawrence Livermore Laboratory.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 29 Sep 1978. Contract W-7405-ENG-48. 109p. Dep. NTIS, PC A06/MF A01.

Conceptual design studies of the target chamber defined the general configuration and dimensions of the chamber and the inlet plenum, orifice plate, and nozzle plate concepts required to generate the desired lithium jet fall. Preliminary studies were performed of the target chamber interfaces with the liquid lithium supply system, the laser system, the pellet injection system, and the target chamber mounting and support system. Target chamber environmental effects resulting from typical thermonuclear burns were evaluated. The outlet region of the target chamber was outlined conceptually, and preliminary design considerations were given to the annular graphite reflector regions of the target chamber and the associated liquid lithium coolant passages. (MOW)

6374 (UCRL—52000-79-10, pp 1-7) **Contamination-control technology.** Oct 1979.

In Energy and technology review.

Contamination of optical surfaces can limit the performance of high-power lasers in two major areas. Within the laser amplifiers, the high-intensity flashlamps can heat contaminants on optical surfaces enough to cause local melting and damage. The presence of contaminants can also initiate intensity modulations on the laser beam that can cause self-focusing of the laser light, local heating further down the optical train, and local beam intensities that exceed the damage threshold of high-quality optical coatings - all effects that tend to prevent the precision focusing required for laser fusion applications. We have developed a large body of standards, measurements, and techniques that enables us to define a clean surface, determine the degree of contamination, and provide optical surfaces of suitable cleanliness. This contamination-control technology attempts to keep optical surfaces free of particulate matter before coating, during installation, and throughout their useful lifetime. It has practically eliminated contamination-related failures in the Shiva laser system.

6375 (UCRL—52000-79-10, pp 8-17) **HYLIFE concept: electricity from laser fusion.** Oct 1979.

In Energy and technology review.

A concept was developed to convert repetitively pulsed energy releases to net electric power. In this design lithium flows in free jets through the reaction chamber, shielding the first structural wall from radiation damage, breeding tritium, yet minimizing the wall stress resulting from the impact of accelerated lithium. The structural wall, consequently, can be made of a common ferritic steel, which can last for the life of the power plant. This design also significantly reduces the amount of residual radioactivity.

6376 (UCRL—52000-79-10, pp 18-24) **Laser-driven shock-wave experiments.** Oct 1979.

In Energy and technology review.

We are developing the capability to measure the equations of state of materials subjected to intense laser-generated shock waves. Our calculations show that pressures between 0.5 and 20 TPa can be reached in laser shock experiments. We now have an accurate technique for measuring shock velocity in these experiments and are designing a technique for measuring mass velocity. Taken together, these two measurements will enable us to trace out Hugoniot curves for a variety of materials in a region of pressure-density space that is poorly understood today. Our work at present focuses on developing accurate diagnostic techniques that have the spatial resolution (micrometres) and time resolution (picoseconds) needed for laser-driven shock experiments and on improving target fabrication techniques. We have already measured shock velocities in aluminum that correspond to pressures up to 1.8 TPa, nearly ten times higher than have been achieved with any other laboratory technique.

6377 (UCRL-Trans—11508) **Calculation of the compression of glass shell targets containing DT gas with allowance for refraction and resonance absorption of CO_2 laser radiation.** Afanas'ev, Yu.V.; Volosevich, P.P.; Gamalii, E.G.; Demchenco, N.N.; Krokhin, O.N.; Rozanov, V.B. (AN SSSR, Moscow. Fizicheskij Inst.). Sep 1979. Translation of Preprint No. 77, Quantum Radiophysics, P.N. Lebedev Physics Institute, Moscow, 1979. 13p. Dep. NTIS, PC A02/MF A01.

A numerical analysis is presented of the laser compression of a thermonuclear target - a thin glass shell filled with DT gas under conditions corresponding to experiments at the Los Alamos Laboratory that are being conducted with a two-beam CO_2 laser. The calculations were made using the Rapid program (P.N. Lebedev Physics Institute of the Academy of Sciences) and the Luch program (Institute of Problems of Mechanics - P.N. Lebedev Physics Institute). Applied to the present calculations, these physicomathematical programs make it possible to investigate the process of the collapse of a given target in both the model of laser ablation of the shell with allowance for processes of refraction and absorption of laser radiation and for electron and ion heat conduction even under the conditions of well-developed hydrodynamics.

6378 **Parabolic lithium mirror for a laser-driven hot plasma producing device.** Baird, J.K. (to Dept. of Energy). US Patent 4,158,598. 19 Jun 1979. Filed date 14 Jun 1976. 8p.

PAT-APPL-695,661.

A hot plasma producing device is provided, wherein pellets, singly injected, of frozen fuel are each ignited with a plurality of pulsed laser beams. Ignition takes place within a void area in liquid lithium contained within a pressure vessel. The void in the liquid lithium is created by rotating the pressure vessel such that the free liquid surface of molten lithium therein forms a paraboloid of revolution. The paraboloid functions as a laser mirror with a reflectivity greater than 90%. A hot plasma is produced when each of the frozen deuterium-tritium pellets sequentially arrive at the paraboloid focus, at which time each pellet is illuminated by the plurality of pulsed lasers whose rays pass through circular annuli across the top of the paraboloid. 2 claims. (MOW)

6379 **Spatial filter system as an optical relay line.** Hunt, J.T.; Renard, P.A. (to Dept. of Energy). US Patent 4,158,176. 12 Jun 1979. Filed date 6 Sep 1977. 6p.

PAT-APPL-830,972.

A system is described that consists of a set of spatial filters that are used to optically relay a laser beam from one position to a downstream position with minimal nonlinear phase distortion and beam intensity variation. The use of the device will result in a reduction of deleterious beam self-focusing and produce a significant increase in neutron yield from the implosion of targets caused by their irradiation with multi-beam glass laser systems. 7 claims.

6380 **Classical energy absorption in practical target illumination schemes.** Howard, J.E. (Univ of Wis, Madison). *IEEE Trans. Plasma Sci.;* **PS-6**: No. 4, 454-463(Dec 1978).

Economic operation of a laser fusion reactor depends critically on the amount of laser energy absorbed by the target. This paper studies collisional absorption by means of geometric optics, which applies whenever the refractive index of the plasma does not change appreciably in a distance of one wavelength. Even at normal incidence, when the ray penetrates to the critical surface, it can be shown that geometric optics gives the correct absorption to within a few percent, except for long laser wavelengths and high-Z materials.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 5993

6381 (CONF-791058—35) **Integral experiments for fusion reactor design: experimentation.** Chapman, G.T.; Morgan, G.L. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

Integral experiments that measure the energy spectra of neutrons and gamma rays due to the transport of ~ 14-MeV T(d,n)^{4}He neutrons through thick steel and borated polyethylene shield configurations have been performed at the Oak Ridge National Laboratory. Descriptions of the facility and experimental techniques are given along with curves showing data representative of the results.

6382 (CONF-791102—30) **Lithium droplet divertor collector for ions and heat.** Wells, W.M. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Coping with the ion and energy fluxes which must be collected with a tokamak divertor is one of the more difficult technological challenges for a power producing reactor. Use of stationary solid surfaces to collect ions and the attendant heat flux faces technology feasibility questions. Calculations indicate that gravity-driven flow of liquid metals having a free surface will not move adequately fast. I'

is proposed to circumvent these problems by having high velocity lithium droplets perform the collection functions. Droplets which are not in contact with a wall encounter only very small retardation effects in a magnetic field, and these droplets can be formed by nozzles outside of the magnetic field. If they travel at about 150 m/s, they can absorb in excess of 1 kW/cm^2 of projected area. The hydrogen isotope ion fluence is well below the saturation dose which has been achieved with lithium.

6383 (HEDL-S/A—1905-FP) **Measurements of neutron spectra from 35 MeV deuterons on thick lithium for the FMIT facility.** Johnson, D.L.; Mann, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1979. Contract EY-76-C-14-2170. 14p. (CONF-791058—41). Dep. NTIS, PC A02/MF A01.

From International conference on nuclear cross sections for technology; Knoxville, TN, USA (22 Oct 1979).

The Fusion Materials Irradiation Test (FMIT) Facility is currently being designed by the Hanford Engineering Development Laboratory (HEDL) at Richland, Washington, USA. This facility will make use of the intense source of high energy neutrons produced by 35 MeV deuterons incident upon a thick liquid lithium target in order to study radiation effects in fusion reactor materials. The experimental aspects and results of measurements of neutron yields and spectra from 35 MeV deuterons on a thick lithium target are described. (MOW)

6384 (LA-UR—79-3111) **Ceramic toroidal vacuum chamber for the ZT-40 experiment.** Dike, R.S.; Haberstich, A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 5p. (CONF-791102—53). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The design and fabrication of the large ceramic vacuum vessel now in use in the ZT-40 experiment are discussed. The torus has a major diameter of 228 cm, a minor diameter of 40 cm, and it is made of 99.5% pure alumina. The design includes a number of sapphire viewing windows as well as ceramic diagnostic and pump ports. Presented are several design features unique in toroidal chamber fabrication using segmented ceramics. The electrical and thermal insulation applied to this vessel is discussed as well as the handling technique used to accomplish final installation in the experiment. (MOW)

6385 (ORNL/TM—6725) **Oak Ridge TNS program: evaluation of a secondary vacuum enclosure for TNS.** Sardella, C. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 85p. Dep. NTIS, PC A05/MF A01.

This report investigates the use of a secondary vacuum enclosure (SVE) to eliminate the need for high vacuum joints between torus sectors and thereby improve device maintainability. Several conceptual SVE designs have been identified and evaluated and the vacuum building was selected as the most promising. A mechanically assembled torus having high impedance seals (rather than vacuum tight seals) between sectors is described and the mechanical characteristics of the device are discussed. The size of the vacuum pump system and the pumpdown time for the vacuum building were determined. Studied also were the many aspects of the effect a vacuum environment has on tokamak systems. The potential benefits of using a SVE on a commercial reactor were investigated and stated in terms of improved plant availability. (MOW)

6386 (ORNL/TM—6727) **ORNL TNS Program: evaluation of the bundle divertor.** Wells, W.M. (Oak Ridge National Lab., TN (USA)). Nov 1979. Contract W-7405-ENG-26. 55p. Dep. NTIS, PC A04/MF A01.

This document provides an investigation of the feasibility of using a bundle divertor on the Reference Design for the Next Step (TNS) evolved at Oak Ridge National Laboratory (ORNL) during FY 1978. Additional information on the Reference Design and the FY 1978 Oak Ridge TNS activities can be found in the associated technical memoranda, ORNL/TM-6720-ORNL/TM 6726 and ORNL/TM-6728-ORNL/TM-6733.

6387 **Divertor for use in fusion reactors.** Christensen, U.R. (to Dept. of Energy). US Patent 4,149,931. 17 Apr 1979. Filed date 16 Jul 1973. 12p.

PAT-APPL-379,870.

A poloidal divertor for a toroidal plasma column ring is described that has a set of poloidal coils co-axial with the plasma ring for providing a space for a thick shielding blanket close to the plasma along the entire length of the plasma ring cross section and all the way around the axis of rotation of the plasma ring. The poloidal coils of this invention also provide a stagnation point on the inside of the toroidal plasma column ring, gently curving field lines for vertical stability, an initial plasma current, and the shaping of the field lines of a separatrix up and around the shielding blanket. 11 claims.

6388 **Damage of metal surfaces by a hot, dense deuterium plasma.** Panayotou, N.F. New York, NY; Columbia Univ. (1979). 95p. University Microfilms Order No. 79-24,954.

Thesis (Ph. D.).

The effect of differences in alloy chemistry and systematic changes in microstructural interface density on the occurrence of unipolar arcing was studied. Unipolar arcing, a plasma-materials effect, is known to be a potent source of plasma impurities that has been observed in tokamak plasma experiments and it may also occur in anticipated Fusion Power Reactors. A high energy density, deuterium plasma device, the Columbia Electromagnetic Shock Tube provides plasma-wall conditions wherein arcing occurs. The plasma is characterized by an ion temperature, T/sub i/ $\sim 10^6$ °K and a particle density of $\sim 10^{16}$ cm^{-3}. (MOW)

6389 **Crossed-field divertor for a plasma device.** Kerst, D.W. (to Dept. of Energy). US Patent Application 963,655. 24 Nov 1978. 12p.

A divertor for removal of charged impurities from the plasma of a Tokamak or similar toroidal plasma device comprises means for dividing the walls of the container of the plasma into a number of sections of electrical conductors that are biased alternately with respect to each other and that are separated by gaps substantially on the equator of the toroid and within a pair of appendages to the walls. A pair of divertor openings is located about 90° from the gaps as seen on a cross section of the toroid that contains the axis of the toroid thus connecting the appendages to the device. The divertor openings are placed at saddles in the poloidal field that are created by a toroidal current-carrying elements enclosed within the appendages. A collector for the unwanted charged particles is placed within each appendage to remove the particles from the plasma for neutralizing and pumping to the exterior.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 5810

6390 (DOE/AD—0010/6) **Selected DOE Headquarters publications, October 1977-September 1979.** (Department of Energy, Washington, DC (USA)). Nov 1979. 149p. Dep. NTIS, PC A07/MF A01.

This sixth issue of cumulative listings of DOE Headquarters publications covers the first two years of the Department's operation (October 1, 1977 - September 30, 1979). It lists two groups of publications issued by then-existing Headquarters organizations and provides an index to their title keywords. The two groups of publications are publications assigned a DOE/XXX-type report number code and Headquarters contractor reports prepared by contractors (and published by DOE) to describe research and development work they have performed for the Department. Certain publications are omitted. They include such items as pamphlets, fact sheets, bulletins, newsletters, and telephone directories, as well as headquarters publications issued under the DOE-tr (DOE translation) and CONF (conference proceedings) codes, and technical reports from the Jet Propulsion Laboratory and NASA issued under DOE/JPL and DOE/NASA codes. The contents of this issue will not be repeated in subsequent issues of DOE/AD-0010. (RWR)

6391 (DOE/CR—0001/3) **DOE uniform contractor reporting system. Volume II. Grants and cooperative agreements.** (Department of Energy, Washington, DC (USA)). Oct 1979. 74p. Dep. NTIS, PC A04/MF A01.

This volume is designed to help those who receive and administer Federal assistance (FA) to acquire useful performance information. The objective is to provide the recipients with a standard means of communicating their progress and results to the Department of Energy (DOE) so that DOE program managers can determine the effectiveness of Federal programs. The reporting system uses a baseline method of management reporting. Work is divided into discrete units and planned in terms of schedule and costs. The schedule and cost plans prepared at the outset are then adopted as standards for managing the project and reporting on its status to DOE. The following plans and reports are addressed: FA management plan, FA milestone plan, FA intermediate event and milestone log, FA cost plan, FA management summary report, FA program/project status report, financial status report, and technical reports. 17 figures. (RWR)

6392 (DOE/EV—0053) **Summary of property damage experience and loss control programs of the United States Department of Energy CY 1978.** (Department of Energy, Washington, DC (USA)). Oct 1979. 85p. Dep. NTIS, PC A05/MF A01.

Calendar year 1978 was the first full year of operation of the Department of Energy. This report summarizes the fire and property damage experience of the Department and includes comparative and cumulative data for prior years for those former agencies that contributed the bulk of DOE facilities and property values. Property damage, from all causes, exceeded $17 million, of which fire losses accounted for nearly $13 million, or 74% of the total. Fire was also the leading cause of death in DOE operations. The fire loss ratio amounted to 2.76 cents/$100 of property values, a figure about equal to the best class of insured industrial properties. The loss ratio from all causes was 3.72 cents/$100, or well under the approximately 5 cents/$100 that is paid by the best class of industry for insurance. While the overall experience was good, the record suffers by comparison with the prior experience of the bulk of the facilities comprising DOE, and further analyses reveal a number of facilities and programs where considerable need for improvement is indicated. 10 figures, 11 tables.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 5455, 5783, 6349

6393 (LA-UR—79-1291) **Comments on the creation of secure operating systems.** Newell, J.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 19p. (CONF-791211—1). Dep. NTIS, PC A02/MF A01.

From 7. symposium on operating systems principles; Pacific Grove, CA, USA (10 Dec 1979).

The predominant general classes of problems that impact secure operating systems for NSI or Military-type environments are reviewed, and research results that can be directed toward solving those problems in a multiuser, multilevel-security virtual system are cited. The subject is developed under the following topics: perspective, internal protection mechanisms, major threats to a military security system, traditional approaches to achieving computer system security, and an approach to the overall problem of creating secure operating systems. It is concluded that although many technical issues remain to be resolved and the production of a secure operating system is still expensive, the state of the art of system design makes such a project feasible and puts a class of verifiably secure virtual systems within grasp.

6394 (LA-UR—79-3232) **FORTRAN callable CAMAC standard subroutines.** Daniels, D.W.; Harrison, J.F.; Kozlowski, T.; Oothoudt, M.A.; Perry, D.G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 3p. (CONF-791215—1). Dep. NTIS, PC A02/MF A01.

From DECUS 1979 fall symposium; San Diego, CA, USA (10 Dec 1979).

An implementation of the COMPUTER AUTOMATED MEASUREMENTS AND CONTROL (CAMAC) Standard Subroutines is presented. CAMAC is a hardware protocol for designing devices in a standard format and lay-out. The standard subroutines represent an effort to carry the standardization of CAMAC over to the programming to facilitate the generation of unambiguous and portable programs. The routines are written in Macro-11 and are designed to be callable from the FORTRAN languages supported on the RSX systems, that is, 11/M and 11/D. Four levels of subroutines are defined--Levels A, B, C, and system dependent. Level A, the simplist, consists of the primary subroutines. They provide the ability to define the CAMAC address of a CAMAC entity and the desired access to it. Level B provide single-action routines. Level C allows block transfers, multiple actions, and inverse declarations. The system dependent routines allow the programmer the flexibility to take advantage of the particular computer system that is being used. Segregating the computer specific routines allows the programmer, when necessary, to write truly portable programs that will be usable on any computer system that adheres to the standard.

6395 (LBL—10189/2) **F45: FTN4 to FTN5 conversion aid reference guide. BKY programming systems bulletin No. 2, 1st edition.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

The FORTRAN Extended (FTN) Version 4 to FORTRAN Version 5 (FTN5) Conversion Aid Program (F45) is designed to produce translations that conform as closely as possible to FTN5. FTN5 includes the complete ANSI FORTRAN 77 standard, but has additional special features. Obsolete or little-used features are not included in FTN5. A few features have changed functionally, but not syntactically; these include the computed GOTO and the DO loop. Over 50 differences exist between FTN4 and FTN5, but most of these differences can be automatically converted with little or no manual effort. The conversion program flags any statements it cannot convert. F45 can produce as it output an entire converted program, or it can generate the UPDATE or MODIFY directives necessary to convert a program stored in program library format. F45 converts only valid FTN4 statements.

6396 (ORNL/CSD/TM—65) **Probabilistic method for grouping data.** Begovich, C.L. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Nov 1979. Contract W-7405-ENG-26. 191p. Dep. NTIS, PC A09/MF A01.

A probabilistic method for grouping data was developed to incorporate measurement error into standard cluster analysis procedures. In the analysis, the data are perturbed by Monte Carlo techniques to simulate the experimental error, and the resultant data sets are clustered. By varying the number of clusters, a procedure is given to estimate the unknown number of groups. This technique and other standard procedures for determining the number of groups are described and compared for three different examples. The probabilistic method is shown to have advantages for determining the number of groups and the probabilities for a sample's membership in the hypothesized groups. 33 figures, 8 tables.

6397 (SAND—79-1545) **Implementing a full duplex communication line under RSX11-M.** Tolendino, L.F.; Vahle, M.O. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 10p. Dep. NTIS, PC A02/MF A01.

RSX11-M does not generally support full duplex communication lines. In order to implement a full duplex communication line using a DUP 11 synchronous interface, two separate drivers were created to service one hardware device.

6398 (SAND—79-2094C) **Minicomputers in Fossil Energy Research at Sandia Laboratories.** (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 20p. (CONF-791213—1). Dep. NTIS, PC A02/MF A01.

From 5. annual MUSE meeting; Fort Lauderdale, FL, USA (3 Dec 1979).

Sandia has been involved in Fossil Energy Research since 1974. The early field experiments clearly pointed to the need for automated data collection, storage, and graphic presentation. Minicomputer systems have been developed which meet these requirements for a very broad class of field experiments. Several projects employing minicomputers are briefly discussed to indicate the similarities of different experiments. The problems that can be directly addressed by automation are discussed. The implemented systems for various experiments are described with attention given to design, generality, and application flexibility. In summary, the field computers utilized in fossil energy research do a job that could not adequately be accomplished by hand. They, together with the equipment at the main offices, have promoted the research toward commercialization of various new energy technologies.

6399 (UCID—18311) **Symmetry conditions for two-dimensional FIR filters.** Goodman, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Sep 1949. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

The problem of designing a two-dimensional FIR filter to approximate a specified frequency response is often simplified by making use of symmetries which appear in the magnitude response. This paper considers the three most obvious symmetries of a transfer function, $H(z_1,z_2)$: quadrantal magnitude symmetry (QMS), diagonal magnitude symmetry (DMS), and octagonal magnitude symmetry (OMS). Necessary and sufficient conditions are developed for all three of these symmetries, both with and without the additional constraint of linear phase. Careful consideration is given to the possibility of anti-symmetry as well as symmetry. (RWR)

6400 (UCID—18329) **Interpolation and data fitting with splines.** Fritsch, F.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1979. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

This is a report on the LLL Continuing Education Course CE1720, Interpolation and Data Fitting with Splines. This 21-lesson course was video-taped during Spring Quarter 1979, and was sponsored by Computation Department's Mathematics and Statistics Section. The following aspects of the course are treated: course description, course requirements, course structure, course outline and schedule, enrollment history, and software availability. 3 figures.

6401 (UCID—30144) **DITHER: a subroutine for simulating gray-level images on TMDS and RJET.** Benenati, C.J.; O'Hair, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1979. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

Subroutine DITHER, when used with appropriate LLL TV80LIB routines, takes gray-level picture data in shaded-raster-line format and produces a pseudo-gray-level picture suitable for viewing on LLL's Television Monitor Display System or Remote Job Entry Terminal electrostatic printer/plotters. DITHER can display a gray-level picture with 512 x 512 resolution as a pseudo-gray-level picture (also with 512 x 512 resolution) on a binary output device. Pictures with higher resolutions are compressed by DITHER to fit the 512 x

512 format. DITHER also produces simulated full color for color TMDS terminals. 4 figures.

6402 (UCID—30156(Rev.1)) **PICTURE: a picture-drawing language for the TRIX/RED report editor.** Beatty, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1979. Contract W-7405-ENG-48. 144p. Dep. NTIS, PC A07/MF A01.

PICTURE is a set of commands for drawing diagrams that are to be plotted by REDPP. PICTURE commands may be included in TRIX/RED source files or may be separately compiled and displayed by REDPP. The PICTURE/REDPP system is also useful for constructing slides, viewgraphs, and movie titles. The program PCOMP (which translates PICTURE statements into REDPP commands), the TRIX/RED report editor, and the RED postprocessor REDPP are all available in public files as part of the Livermore time-sharing system. 44 figures.

6403 (UCRL—83259) **Numerical methods for stiff differential equations - getting the power to the people.** Hindmarsh, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1979. Contract W-7405-ENG-48. 7p. (CONF-800201—1). Dep. NTIS, PC A02/MF A01.

From COMPCON 1980; San Francisco, CA, USA (25 Feb 1980).

The realization of problems associated with stiff differential equations (DE) is recalled. Stiffness and the so-called BDF methods (early found to be effective on stiff problems) are described. The ways in which these methods have achieved success are discussed, along with ways in which they and related ideas might do a better job in the future of solving stiff DE. The impact of the hardware environment is included. 1 figure. (RWR)

6404 (UCRL—83549) **M-dimensional linear systems: determination of impulse response support, computing cepstra, and recursibility issues.** Goodman, D.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Nov 1979. Contract W-7405-ENG-48. 7p. (CONF-791125—2). Dep. NTIS, PC A02/MF A01.

From 13. Asilomar conference on circuits, systems, and computers; Pacific Grove, CA, USA (5 Nov 1979).

Conditions for the cepstrum of a bounded-support M-D sequence to exist and be l^1 (absolutely summable) are developed, and the support of the cepstrum is related to the support of the l^1 inverse of this sequence. The case in which the cepstrum can be computed recursively is discussed, and a general stability theorem for all-pole recursible difference equations is developed.

6405 (UCRL—83678) **Video driver/extended memory for the LSI-11.** Lockhart, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1979. Contract W-7405-ENG-48. 6p. (CONF-791215—4). Dep. NTIS, PC A02/MF A01.

From DECUS 1979 fall symposium; San Diego, CA, USA (10 Dec 1979).

The video driver and extended memory are mounted on two large quad sized PC boards which plug into the LSI-11 Q-Bus. The design incorporates many features to facilitate text editing operations including a linked list, a cursor and the display enhancements. Most of the system parameters are programmable including the CRT controller chip. There are two 128 character generators, one being user programmable RAM. The large display memory can be read or written from the CPU through a memory map register and can function as extended memory to the LSI-11. Typical text displays are 51 lines of 80 characters. In the graphics mode, the displayed field is 512 by 512 pixels. In addition to the CPU port, there is an external port which has access to the display memory, a design feature that can facilitate other uses for the video driver system.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

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Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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EA-77-A-01-6010-035	**National Bureau of Standards, Washington, DC (USA). Center for Materials Science**	
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EC-77-C-01-5113	**TRW, Inc., McLean, VA (USA). Energy Systems Group**	
	5:5795	CONS—5113-T4
EC-77-C-02-4161	**Minnesota Energy Agency, St. Paul (USA)**	
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EC-77-C-02-4213	**Independence, City of, MO (USA)**	
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EC-77-C-07-1672	**Midland-Ross Corp., Toledo, OH (USA). Technical Center - Thermal Systems**	
	5:5927	CONS—1672-T1
EC-78-C-01-4131	**Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center**	
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EE-77-S-02-4472	**Case Western Reserve Univ., Cleveland, OH (USA)**	
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EF-77-A-01-257	**Mason and Hanger-Silas Mason Co., Inc., Lexington, KY (USA)**	
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EF-77-C-01-2455	**Burns and Roe, Inc., Woodbury, NY (USA)**	
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EF-77-C-01-2689	**Germantown Labs., Inc., Philadelphia, PA (USA)**	
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EF-77-C-01-2709	**Airco Cryogenics, Irvine, CA (USA)**	
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EF-77-C-03-1472	**Gulf Research and Development Co., Pittsburgh, PA (USA)**	
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EF-77-S-01-2710	**Pennsylvania State Univ., University Park (USA). Dept. of Chemistry**	
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EG-77-C-01-4042	**Solar Energy Research Inst., Golden, CO (USA)**	
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EG-77-C-02-4258	**Colorado Energy Research Inst., Golden (USA)**	
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EG-77-S-02-4546	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
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EI-78-C-01-6366	**Energy Management Associates, Inc., Atlanta, GA (USA)**	
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EI-78-C-01-6434	**Ideamatics, Inc., Washington, DC (USA)**	
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EI-78-C-01-6548	**Logistics Management Inst., Washington, DC (USA)**	
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EK-78-C-39-0028	**Institute for Defense Analyses, Arlington, VA (USA). Program Analysis Div.**	
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EM-78-C-03-2184	Aerospace Corp., El Segundo, CA (USA)	
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ER-78-S-02-4861	Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering	
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ET-78-C-01-3092	Energy and Environmental Analysis, Inc., Arlington, VA (USA)	
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ET-78-C-01-3182	Water Purification Associates, Cambridge, MA (USA)	
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ET-78-S-01-3031	Carnegie-Mellon Inst. of Research, Pittsburgh, PA (USA)	
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EU-78-C-01-6647	Kramer Associates, Inc., Washington, DC (USA)	
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EW-78-C-19-0042	Institute of Gas Technology, Chicago, IL (USA)	
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EW-78-F-07-1761	Mississippi State Univ., Mississippi State (USA). Engineering and Industrial Research Station	
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EX-76-C-01-2449	Carnegie-Mellon Univ., Pittsburgh, PA (USA)	
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EX-76-S-01-2496	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Energy and Environmental Studies	
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EY-76-C-03-0893-030	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
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EY-76-S-02-2146	Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Physics	
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40	5:6234	*See* PNL-SA-6950
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1	5:5970	*See* COO-2422-21
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1	5:5375	Dep. NTIS, PC A03/MF A01
CONF-790125-	(1. topical meeting on fusion reactor materials, Miami Beach, FL, USA, 29-31 Jan 1979)	
83	5:5993	*See* UWFDM-286
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1	5:5386	*See* UCRL-83531
CONF-7903100-	(American Crystallography Association meeting, Honolulu, HI, USA, 26-30 Mar 1979)	
1	5:5962	*See* LBL-9098
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5	5:5796	*See* LBL-9834
CONF-7905119-	(Annual meeting of the task group on water chemistry of the Gesellschaft Deutscher Chemiker, Bad Pyrmont, F.R. Germany, 21-23 May 1979)	
1	5:6176	*See* INKA-CONF-79-187-002
CONF-7905122-	(Corrosion and corrosion prevention in barried pipelines and containers conference, Sprendlingen, F.R. Germany, 30-31 May 1979)	
(Absts.)	5:5983	*See* INKA-Conf-79-214-000
CONF-7905124-	(9. international congress of carboniferous stratigraphy and geology, Urbana, IL, USA, 19-26 May 1979)	
1	5:5325	Dep. NTIS, PC A03/MF A01
CONF-790602-	(ANS annual meeting, Atlanta, GA, USA, 3-8 Jun 1979)	
89	5:5417	*See* HEDL-SA-1723
90	5:5418	*See* HEDL-SA-1727-FP
CONF-790610-	(International conference on nuclear physics with electromagnetic interactions, Mainz, F.R. Germany, 5-9 Jun 1979)	
6	5:6289	*See* SLAC-PUB-2432
CONF-790615-	(3. US national congress on pressure vessels and piping, San Francisco, CA, USA, 25-29 Jun 1979)	
28	5:5734	$3.00
CONF-790638-	(3. annual biomass energy systems conference, Golden, CO, USA, 5-7 Jun 1979)	
6	5:5490	*See* LBL-9190
7	5:5491	*See* LBL-9191
CONF-790640-	(18. symposium on engineering aspects of magnetohydrodynamics, Butte, MT, USA, 18-20 Jun 1979)	
6	5:5877	Dep. NTIS, PC A02/MF A01
CONF-790661-	(Western Economics Association annual meeting, Las Vegas, NV, USA, 17-21 Jun 1979)	
2	5:5897	Dep. NTIS, PC A03/MF A01
CONF-790663-	(Symposium on analysis of waters associated with alternate fuel production, Pittsburgh, PA, USA, 4-5 Jun 1979)	
2	5:5392	*See* PNL-SA-7795
CONF-790681-	(3. solar photochemistry research conference, Pacific Grove, CA, USA, 19-22 Jun 1979)	
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CONF-7906139-	(Euromech colloquium 115 mechanical behavior of anisotropic solids, Grenoble, France, 19-22 Jun 1979)	
1	5:6265	*See* SAND-79-2028C
CONF-790707-	(20. annual meeting of the Institute of Nuclear Materials Management, Albuquerque, NM, USA, 16-19 Jul 1979)	
35	5:5428	*See* PNL-SA-7548
CONF-790709-	(VII international AIRAPT conference, La Creusot, France, 30 Jul-3 Aug 1979)	
17	5:5356	*See* UCRL-83448
CONF-790743-	(Symposium on heavy ion physics from 10-200 MeV/A, Upton, NY, USA, 16-20 Jul 1979)	
8	5:6325	*See* LBL-9520
CONF-790749-	(Conference on advanced materials for alternate fuel capable directly fired heat engines, Castine, ME, USA, 30 Jul-3 Aug 1979)	
2	5:6001	*See* PNL-SA-7809
3	5:5955	*See* PNL-SA-7888
CONF-790757-	(ARPA/AF review of progress in quantitative NDE, La Jolla, CA, USA, 8-13 Jul 1979)	
3	5:6092	Dep. NTIS, PC A02/MF A01
CONF-790770-	(Management assessment of peat as an energy resource meeting, Arlington, VA, USA, 22-24 Jul 1979)	
1	5:5292	Chicago, IL; Institute of Gas Technology (1979).
CONF-790802-	(International conference on structural mechanics in reactor technology, Berlin, F.R. Germany, 13-17 Aug 1979)	
78	5:5750	*See* HEDL-SA-1642-FP
CONF-790816-	(International meeting on fast reactor safety technology, Seattle, WA, USA, 19-23 Aug 1979)	
69	5:5768	*See* HEDL-SA-1741-FP
74	5:5769	*See* HEDL-SA-1770
75	5:5756	Dep. NTIS, PC A02/MF A01
77	5:5765	*See* HEDL-SA-1712-FP
78	5:5767	*See* HEDL-SA-1716-FP
79	5:5766	*See* HEDL-SA-1714-FP
80	5:5724	*See* GA-A-15555
81	5:5725	*See* GA-A-15562
CONF-790822-	(87. AICHE national meeting, Boston, MA, USA, 19 Aug 1979)	
14	5:5294	Inst. of Gas Tech., Chicago, IL
16	5:5333	Dep. NTIS, PC A03/MF A01
CONF-790843-	(8. international conference on atomic collisions in solids, Hamilton, Canada, 13-17 Aug 1979)	
10	5:6272	Dep. NTIS, PC A02/MF A01
11	5:6273	*See* COO-3158-80
12	5:5988	*See* COO-3158-79
CONF-790855-	(Symposium on instrumentation and control for fossil energy processes, Denver, CO, USA, 20-22 Aug 1979)	
6	5:5293	Chicago, IL; Institute of Gas Technology (1979).
CONF-790882-	(10. international radiocarbon conference, Bern, Switzerland, 19-26 Aug 1979)	
2	5:6124	Dep. NTIS, PC A02/MF A01
CONF-790884-	(Post-SMiRT5 second international seminar on mathematical/mechanical modeling of reactor fuel elements, Berlin, F.R. Germany, 20-21 Aug 1979)	
2	5:5721	Dep. NTIS, PC A02/MF A01
CONF-790885-	(9. international symposium on lepton and photon interactions at high energy, Batavia, IL, USA, 23-29 Aug 1979)	
7	5:6126	*See* SLAC-PUB-2405
CONF-790891-	(3. international conference on surface and colloid chemistry, Stockholm, Sweden, 20-25 Aug 1979)	
1	5:5350	Dep. NTIS, PC A03/MF A01
CONF-790894-	(1. conference on ground control problems in the Illinois coal basin, Carbondale, IL, USA, 22-24 Aug 1979)	
1	5:5324	Dep. NTIS, PC A03/MF A01
CONF-790909-	(International conference on magnetism, Munich, F.R. Germany, Sep 1979)	
13	5:6327	Dep. NTIS, PC A02/MF A01
CONF-790912-	(9. European conference on controlled fusion and plasma physics, Oxford, UK, 17-21 Sep 1979)	
10	5:6353	*See* COO-2218-138
11	5:6346	*See* COO-2218-137
CONF-790917-	(American Chemical Society national meeting, Washington, DC, USA, 10-14 Sep 1979)	
17	5:6008	Dep. NTIS, PC A02/MF A01
CONF-790923-	(Decontamination and decommissioning of nuclear facilities conference, Sun Valley, ID, USA, 16-19 Sep 1979)	
6	5:6045	*See* RFP-2901
8	5:6125	Dep. NTIS, PC A02/MF A01
CONF-790933-	(IAEA international symposium on fast reactor physics, Aix-en-Provence, France, 24-28 Sep 1979)	

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2	5:6147	*See* UCRL-82499
CONF-790966-	(International conference on acoustic emission, Anaheim, CA, USA, 10-13 Sep 1979)	
2	5:6094	*See* HEDL-SA-1808-FP
CONF-790968-	(6. international conference on atomic masses, East Lansing, MI, USA, 18-21 Sep 1979)	
5	5:6307	*See* LA-UR-79-2827
6	5:6312	*See* LBL-9876
9	5:6334	Dep. NTIS, PC A02/MF A01
CONF-790976-	(International symposium on future directions in studies of nuclei far from stability, Nashville, TN, USA, 10-13 Sep 1979)	
6	5:6322	*See* BNL-26770
CONF-790990-	(Meeting on nutritional assessment-present status, future directions and prospects, Santa Fe, NM, USA, 24-27 Sep 1979)	
1	5:6024	*See* BNL-26819
CONF-790992-	(FEBS symposium on DNA, Prague, Czechoslovakia, 24-29 Sep 1979)	
1	5:6232	Dep. NTIS, PC A02/MF A01
CONF-790993-	(Symposium on dense gas, Frankfurt, F.R. Germany, 3-4 Sep 1979)	
1	5:6179	*See* PNL-SA-7952
CONF-790994-	(26. Pacific Northwest regional meeting of the American Geophysical Union, Bend, OR, USA, 17-18 Sep 1979)	
1	5:5457	*See* PNL-SA-7897
CONF-790995-	(International conference on radiation physics in semiconductors and related materials, Tbilisi, USSR, 13-19 Sep 1979)	
1	5:5991	*See* LBL-9901
CONF-7909100-	(American Society of Metals seminar, Milwaukee, WI, USA, 15-16 Sep 1979)	
1	5:5959	Dep. NTIS, PC A04/MF A01
CONF-7909101-	(3. europhysical topical conference on lattice defects in ionic crystals, Canterbury, UK, 17-21 Sep 1979)	
1	5:6009	Dep. NTIS, PC A02/MF A01
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CONF-7909102-	(Argonne specialists' workshop on basic research needs for nuclear waste management, Argonne, IL, USA, 5-6 Sep 1979)	
1	5:6044	Dep. NTIS, PC A02/MF A01
CONF-7909103-	(Small business seminar, Chicago, IL, USA, 28 Sep 1979)	
1	5:5932	Dep. NTIS, PC A02/MF A01
CONF-791009-	(International conference on energy use management, Los Angeles, CA, USA, 22-26 Oct 1979)	
9	5:5929	Chicago, IL; Institute of Gas Technology (1979).
CONF-791014-	(4. annual conference on materials for coal conversion and utilization, Gaithersburg, MD, USA, 9-11 Oct 1979)	
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4	5:5804	*See* LA-UR-79-2895
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13	5:6023	*See* LBL-9793
CONF-791024-	(Solar industrial process heat conference, San Francisco, CA, USA, 31 Oct-2 Nov 1979)	
7	5:5651	*See* SERI/TP-333-427
CONF-791030-	(7. conference on inadvertent and planned weather modification, Banff, Alberta, Canada, 8-12 Oct 1979)	

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4	5:6131	*See* LA-UR-79-2832
CONF-791045-	(American Ceramic Society conference, New Orleans, LA, USA, 14-17 Oct 1979)	
4	5:5419	*See* HEDL-SA-1895-FP
6	5:6007	*See* HEDL-SA-1833-FP
CONF-791049-	(23. conference on analytical chemistry in energy technology, Gatlinburg, TN, USA, 9-11 Oct 1979)	
16	5:6025	*See* LA-UR-79-2759
19	5:6048	*See* MLM-2677(OP)
20	5:6029	*See* MLM-2676(OP)
CONF-791051-	(3. ASTM-EURATOM symposium on reactor dosimetry, Ispra, Italy, 1-5 Oct 1979)	
6	5:6320	*See* LA-UR-79-2703
7	5:5751	*See* HEDL-SA-1917-FP
14	5:5990	*See* HEDL-SA-1784
CONF-791058-	(International conference on nuclear cross sections for technology, Knoxville, TN, USA, 22-26 Oct 1979)	
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40	5:6310	*See* HEDL-S/A-1908-FP
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42	5:6314	*See* HEDL-SA-1907
44	5:6306	*See* HEDL-SA-1906-FP
45	5:6329	*See* LA-UR-79-3201
46	5:6311	*See* UCRL-82999
CONF-791070-	(American flame research committee meeting, Houston, TX, USA, 22-23 Oct 1979)	
1	5:6052	Chicago, IL; Institute of Gas Technology (1979).
CONF-791076-	(DOE statistical symposium, Oak Ridge, TN, USA, 25-26 Oct 1979)	
1	5:6239	*See* LA-UR-79-2782
CONF-791077-	(Workshop on measurement and interpretation of actinide accumulation by man, Snowbird, UT, USA, 14-18 Oct 1979)	
1	5:6240	*See* LA-UR-79-2830
CONF-791078-	(32. gaseous electronics conference, Anaheim, CA, USA, 9-12 Oct 1979)	
1	5:6278	*See* LA-UR-79-2822
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1	5:5985	*See* RFP-3018
2	5:6143	*See* UCRL-82723
CONF-791086-	(US/United Kingdom information exchange on dissolution of nuclear fuel, Windscale, UK, 16-18 Oct 1979)	
3	5:5426	*See* HEDL-SA-1935
CONF-791087-	(US/FRG bilateral workshop on waste isolation performance assessment and in-situ testing, Berlin, F.R. Germany, 1-5 Oct 1979)	
1	5:5467	*See* SAND-79-1959C
CONF-791088-	(National safety congress, Chicago, IL, USA, 15-19 Oct 1979)	
2	5:6235	*See* LA-UR-79-3140
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1	5:6153	*See* COO-1199-59
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1	5:5372	*See* SAND-79-2031C
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53	5:6384	*See* LA-UR-79-3111
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42	5:5449	Dep. NTIS, PC A02/MF A01
43	5:6043	*See* BNL-26812
44	5:5755	*See* BNL-NUREG-2
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49	5:6332	*See* HEDL-SA-1867-FP
50	5:6072	*See* HEDL-SA-1888-FP
53	5:6130	*See* GA-A-15496
55	5:6073	*See* LA-UR-79-3091
56	5:5424	*See* DPSPU-79-30-12A
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21	5:5460	*See* SAND-79-0911C
23	5:5453	*See* LA-UR-79-2992
25	5:5470	*See* UCRL-83488
28	5:5450	Dep. NTIS, PC A02/MF A01
29	5:5464	*See* SAND-79-1076C
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16	5:5477	*See* SAND-79-1071C
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1	5:5749	Dep. NTIS, PC A02/MF A01
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2	5:6404	*See* UCRL-83549
CONF-791129-	(Workshop on wind climate, Ashville, NC, USA, 11-13 Nov 1979)	
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1	5:5979	Dep. NTIS, PC A02/MF A01
2	5:6142	*See* SAND-79-2001C
3	5:6021	*See* COO-1198-1280
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1	5:5408	*See* LA-UR-79-3249
CONF-791139-	(ACPA conference on visibility, Denver, CO, USA, 26-28 Nov 1979)	
2	5:6154	*See* LA-UR-79-3250
CONF-791140-	(2. symposium on uranium mill tailings management, Fort Collins, CO, USA, 19-20 Nov 1979)	
1	5:6244	*See* LA-UR-79-3045
CONF-791142-	(International Conference on crystal field and structural effects in f-electron systems, Philadelphia, PA, USA, 12-15 Nov 1979)	
3	5:6337	*See* LA-UR-79-3174
4	5:6286	*See* LA-UR-79-3144

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1	5:5443	*See* K/ET-5010
CONF-791203-		(Health Physics Society meeting, Honolulu, HI, USA, 10-14 Dec 1979)
5	5:5422	Dep. NTIS, PC A02/MF A01
CONF-791204-		(2. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 10-13 Dec 1979)
2	5:5290	*See* MLM-2671(OP)
5	5:5355	*See* SAND-79-0771C
CONF-791211-		(7. symposium on operating systems principles, Pacific Grove, CA, USA, 10-12 Dec 1979)
1	5:6393	*See* LA-UR-79-1291
CONF-791213-		(5. annual MUSE meeting, Fort Lauderdale, FL, USA, 3-6 Dec 1979)
1	5:6398	*See* SAND-79-2094C
CONF-791214-		(Conference on auctions and competitive bidding, Mt. Kisco, NY, USA, 6-8 Dec 1979)
1	5:5812	*See* LA-UR-79-3259
CONF-791215-		(DECUS 1979 fall symposium, San Diego, CA, USA, 10-13 Dec 1979)
1	5:6394	*See* LA-UR-79-3232
4	5:6405	*See* UCRL-83678
CONF-791218-		(6. annual conference of the data general users group, New Orleans, LA, USA, 4 Dec 1979)
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1	5:5783	*See* SAND-79-0956C
2	5:5727	*See* GEFR-SP-177
CONF-800104-		(18. AIAA aerospace sciences meeting, Pasadena, CA, USA, 14-16 Jan 1980)
2	5:6059	*See* SAND-79-1347C
CONF-800105-		(17. annual international Stockmen's School, Tucson, AZ, USA, 7-10 Jan 1980)
1	5:6212	*See* LA-UR-79-1822
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